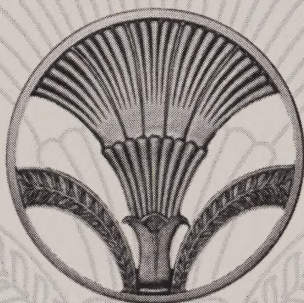


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MYCOTAXON

THE INTERNATIONAL JOURNAL OF FUNGAL TAXONOMY & NOMENCLATURE

Volume 96

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Pacific Northwest Mycology Service

6720 NW Skyline Boulevard

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The genera *Inocutis* and *Inonotus* (Hymenochaetales) in Uruguay

SEBASTIÁN MARTÍNEZ

sebamart@fing.edu.uy

Laboratorio de Micología

Facultad de Ingeniería/ Ciencias, J. Herrera y Reissig 565

11300 Montevideo, Uruguay

Abstract—Species of *Inocutis* and *Inonotus* from Uruguay were studied. *Inocutis texana* comb. nov. and *Inonotus ochroporus* are recorded for the first time from Uruguay and compared with type and representative material. A complete description and illustration of both species are provided. Two species of *Inocutis* and three of *Inonotus* are known from Uruguay. A key for the five species is presented. The homogeneity and validity of the genus *Inocutis* is discussed. Sclerified hyphae from the rudimentary granular core of *Inocutis jamaicensis* is described for the first time.

Key Words—Basidiomycetes, *Inonotus venezuelicus*, polypores, taxonomy, wood-rot

Introduction

The genus *Inonotus* P. Karsten was proposed in 1879 to accommodate species of polypores with a pileate habit and pigmented basidiospores. Later, Donk (1933), emended the genus to encompass all the species with pigmented basidiospores and a brown context, characters present in *I. cuticularis* (Bull.) P. Karst., the type species (Ryvarden 1991). However, the concept of this genus was enlarged to include species with a great variation with regard to habit of the basidiocarp, shape of the basidiospores, type and pigmentation of the spore wall and presence or absence of setae. Characters that remained constant to the expanded species concept include the presence of a brown fibrous context, xanthochroic reaction of the basidiocarp when exposed to KOH or another alkali solution, and a monomitic hyphal system with simple septate hyphae.

Some characters are of limited value for delimiting polypore genera (Ryvarden 1991) and others intergrade with the closely related genus *Phellinus* Quélet. The distinction between the genera was reduced to the mitism of the hyphal system and the consistency and durability of the basidiocarps—dimitic (hard and perennial in *Phellinus*) versus monomitic, (soft and annual) in *Inonotus*. However, intermediate forms exist side by side in both genera (Corner 1991; Fiasson & Niemelä 1984; Gilbertson & Ryvarden 1986, 1987; Larsen & Cobb-Pouille 1990).

There is growing morphological and molecular evidence to indicate that *Inonotus* is not a monophyletic genus. Some authors have divided *Inonotus* s.l. into more natural and smaller genera (Murrill 1904, Fiasson & Niemelä 1984). Fiasson & Niemelä (1984)

created *Inocutis* to accommodate the European species of the *Inonotus rheades* group, or *Inonotus* sect. *Phymatopilus* (Donk 1974, Fiasson & Niemelä 1984). Based on the absence of setae and the presence of a marmorate core in the basidiocarps, Fiasson & Niemelä (1984) transferred three European species of this group—*I. dryophilus* (Berk.) Murrill, *I. rheades* (Pers.) P. Karst. and *I. tamaricis* (Pat.) Maire—to *Inocutis*. In addition, these species of *Inocutis* have a unique pattern of pigments and sclerified hyphae in the marmorate core (Fiasson 1982, Gilbertson & Ryvarden 1986, Ryvarden & Gilbertson 1993). Recently, Wagner & Fischer (2001, 2002) showed that *Inocutis* is a well-supported monophyletic genus in the *Hymenochaetales* that encompasses the European *I. rheades* group along with *Inonotus jamaicensis* and *Xanthochrous ludovicianus* Pat., two American species. Gottlieb et al. (2002) arrived at the same conclusion working with internal transcribed spacer sequences.

Inonotus s. l. is poorly studied in Uruguay. Only two species are historically well known—*Inonotus rickii* (Pat.) D. A. Reid, found mainly on *Acer* and *Platanus* in Southern Uruguay (Bettucci & Guerrero 1971), and *I. patouillardii* (Rick) Imazeki, recorded on *Celtis* and *Platanus* (Gazzano 1998). Recently, *Inocutis jamaicensis* was identified as the causal agent of wood-rot and deformation of *Eucalyptus* stems in southeastern and northwestern Uruguay (Martínez 2005); it was misidentified as *I. splitgerberi* (Mont.) Ryvarden earlier (Martínez et al. 2002).

The main objective of the present work is to record for the first time from Uruguay two species of *Inonotus* s.l. recently collected, describe both species, to survey the genus for the country, and to contribute additional data to help circumscribe the genus *Inocutis*.

Materials and Methods

Uruguay specimens were compared with type and representative specimens from four herbaria—BAFC, BPI, MVHC and NY (Holmgren et al. 1990). Microscopic examinations were made from freehand sections mounted in 5% KOH solution and 1% phloxine, in Melzer reagent (IKI), and in 0.5% cotton blue (CB) in 25% lactophenol (Kirk et al. 2001). Species were identified and compared using keys and descriptions from Pegler (1964), Urcelay & Rajchenberg (1999), Gottlieb et al. (2002) and Ryvarden (2004, 2005). Authors of fungal names are according to Kirk and Ansell (1992).

Results

Inocutis jamaicensis (Murrill) A. M. Gottlieb, J. E. Wright & Moncalvo, Myc. Prog. 1: 308. 2002. Fig. 1.

Basionym: *Inonotus jamaicensis* Murrill, Bull. Torr. Bot. Club 31: 597. 1904. (NY!)

Descriptions: Gilbertson & Ryvarden (1987), Gottlieb et al. (2002), Martínez (2005), Pegler (1964) and Rajchenberg & Wright (1998).

Remarks: For specimens studied see Martínez (2005). *Inocutis jamaicensis* is widely distributed in the Americas, and is reported to cause stem decay in *Eucalyptus* spp. in Uruguay (Martínez 2005). A character previously unreported is sclerified hyphae that are present in some sections of the context (Figure 1). Although sclerified hyphae are characteristic of the genus *Inocutis*, they are present only in some specimens and are easily

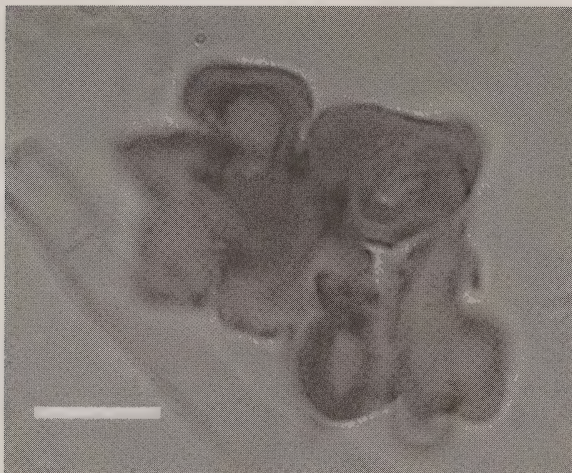


FIGURE 1. Microscopical photograph of sclerified hyphae from granular core of *Inocutis jamaicensis*. Scale bar = 10 μ m.

broken in squash mounts. Gottlieb et al. (2002) reported the presence of a rudimentary granular core and black lines in the context. These black lines in the context can be easily verified in many specimens studied from Uruguay, but a rudimentary granular core was not observed previously (Martínez 2005). Both characters are correlated with age, habit of the basidiocarp and the way in which the specimens were collected. Most of the Uruguayan specimens come from standing eucalypt trees where the basidiocarps develop in a pileate fashion (Martínez 2005). In older specimens collected with bark, a thin zone of granulose context was observed at the basidiocarp-substrate interface. Sclerified hyphae were observed in the granular core. Thus the habit and age of the specimen has a direct bearing on whether a granular core is present and if sclerified hyphae are observed.

***Inocutis texana* (Murrill) Seb. Martínez, comb. nov.**

Fig. 2a-d.

Basionym: *Inonotus texanus* Murrill, Bull. Torr. Bot. Club 31: 597. 1904. (NY!)

Basidiocarp annual, sessile, nodulose to ungulate, 40–70 x 25–45 x 15–50 mm. Pileus circular, glabrous, concentrically cracking in age, dark brown to almost black in old specimens. Hymenial surface creamish brown to dark yellowish brown. Context corky to fibrous, very thin, up to 5 mm thick, golden brown. Rudimentary granular core present in some specimens. When present, granular core containing sclerified hyphae, with short branches. Tubes brittle, ferruginous brown, up to 45 mm long. Pores irregular, smaller at margin, lacerate, 1–4/mm. Hyphal system monomitic, generative hyphae thin to thick walled, hyaline to reddish brown, 4–9 μ m diam., occasionally branched. Contextual hyphae mostly thick walled, yellowish to reddish brown, 4–10 μ m diam., occasionally branched. Tramal and hymenial setae absent. Spores abundant, yellowish to golden reddish, subglobose, smooth, thick-walled, 8.0–9.0 x 6.0–7.0 μ m.

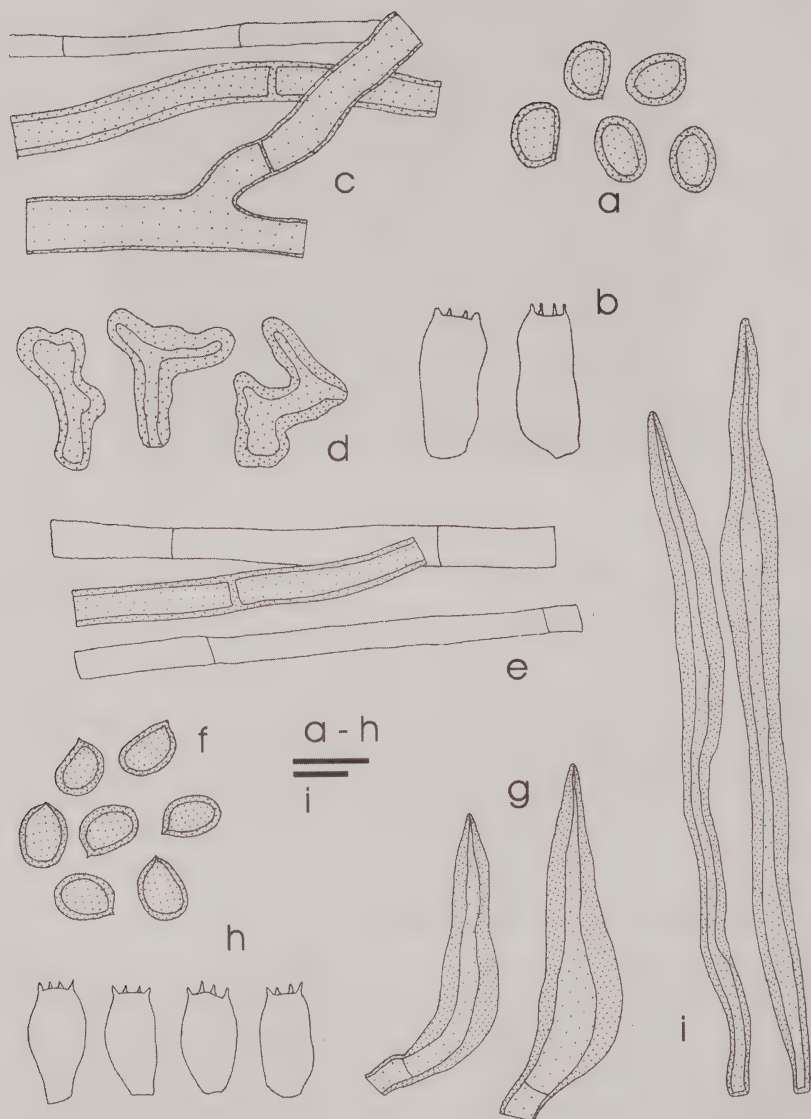


FIGURE 2. Microscopical characters of *Inocutis texana* (a-d) and *Inonotus ochroporus* (e-i). a. basidiospores; b. basidia; c. contextual and tramal hyphae; d. sclerified hyphae (a.-c. from MVHC 5259, d. from Holotype). e. tramal hyphae; f. basidiospores; g. hymenial setae; h. basidia; i. tramal setae. (All from MVHC 5302). Scale bars = 10 μ m.

Distribution: Argentina (Urcelay & Rajchenberg 1999, Gottlieb et al. 2002), U.S.A. (Pegler 1964, Gilbertson & Ryvarden 1986), Uruguay.

Substrates: *Acacia*, *Diostea*, *Morus*, *Prosopis*, *Salix*, *Schinopsis* (Gottlieb et al. 2002, Gilbertson & Ryvarden 1986, Pegler 1964, Urcelay & Rajchenberg 1999), *Lithraea*.

SPECIMENS EXAMINED: ARGENTINA. LA RIOJA Río La Carpintería, 1 km antes de Los Molinos, desde el S, on *Acacia furcatispina*, leg. O. Di Iorio, I-2001 (BAFC50971). CATAMARCA: San Pablo, Dpto. de Capayán, leg. V. Suárez & A. Gottlieb #53, 22-III-1995 (BAFC33667). SANTIAGO DEL ESTERO: Dpto. Copo, Reserva de Copo, leg. J. Protomastro, III-1986 (BAFC30686). San Luis, Carpintería, on *Prosopis* sp., leg. O. Herrera, IV-1971 (BAFC50287).- URUGUAY. DPTO. LAVALLEJA: Minas, Paraje Campanero, on *Lithraea* sp., leg. G. Pérez, 18-IV-2003. (MVHC5259).- USA. Texas: Austin. on mesquite?, leg. Underwood, 24-XI-1891 (*Inonotus texanus*, Holotype NY!).

Remarks: This is the first report of *I. texana* for Uruguay. This species is well known from southwestern U.S.A. on *Acacia* sp. and *Prosopis* sp. (*Fabaceae*) (Gilbertson & Ryvarden 1986). Recently, Urcelay & Rajchenberg (1999) recorded this species from Argentina on *Acacia* sp., *Prosopis* sp. and *Schinopsis* sp. (*Anacardiaceae*) and Gottlieb et al. (2002) added *Diostea* sp. (*Verbenaceae*) to the host species. The Uruguayan collection is on *Lithraea* sp. (*Anacardiaceae*), and thus is able to collect this species on other substrata.

Gilbertson & Ryvarden (1986) observed a well developed granular core in this species, although Urcelay & Rajchenberg (1999) and Gottlieb et al. (2002) recorded only a rudimentary granular core in specimens from Argentina. A granular core was not observed in the Uruguayan specimen studied for it is composed of small fragments of a very young basidiocarp. The holotype is composed of small and blackened fragments with segments of different texture in the context. Under the microscope, sclerified hyphae were seen that were identical to those described by Gilbertson & Ryvarden (1986) (Figure 2d.). Sclerified hyphae were observed in some of the Argentinean specimens, but were absent in the Uruguayan specimen. Because *I. texana* shares with *I. jamaicensis* a similar hyphal system, granular core with sclerified hyphae, lack of setae, and spore type, its transfer to *Inocutis* is justified.

Inonotus ochroporus (Van der Byl) Pegler, Trans. Brit. Mycol. Soc. 47(2): 183. 1964.

Fig. 2e-i.

Basionym: *Polyporus ochroporus* Van der Byl., S. Afr. J. Sci. 18: 269. 1922.

Basidiocarp annual, dimidiate, sessile, 55–140 x 35–80 x 15–50 mm. Pileus circular, applanate to ungulate, single, glabrous, azonate, rusty brown to dark brown. Hymenial surface ochraceous to dark brown, blackish and radially cracked in old specimens. Context fibrous, soft, dark golden brown to chocolate brown, up to 30 mm thick. Tubes darker, up to 45 mm long. Pores irregular to angular, lacerated, 4–6/mm. Margin rounded to blunt. Hyphal system monomitic, generative hyphae thin-walled to thick-walled, hyaline to yellowish brown, 4–7 µm in diameter. Contextual hyphae thick-walled, dark reddish brown, 8–10 µm in diameter. Tramal setae brown, straight, lanceolate, mostly parallel to the tubes, 100–180 x 8–15 µm. Hymenial setae rare, ventricose, 20–50 x 8–12 µm. Basidia subglobose to clavate, 12–18 x 6–8 µm. Spores ellipsoid, thick-walled, yellowish, 7.5–9 x 5.5–7 µm.

Distribution: Argentina (Gottlieb et al., 2002), Eastern Africa: Kenya, Tanzania, Uganda (Ryvarden & Johansen 1980), South Africa, West Pakistan (Pegler 1964), Uruguay.

Substrates: *Casuarina*, *Ficus*, *Lithraea*, *Salix* (Gottlieb et al., 2002, Pegler 1964).

SPECIMENS EXAMINED: ARGENTINA. CORRIENTES: Dpto. Capital, Riachuelo, leg. Schinini & Cristóbal 12169, 27-VI-1974 (BAFC 50291). CHACO: San Bernardo, on *Casuarina cunninghamiana*, leg. Di Iorio (det. J. Wright & E. Blanchet), V-1995 (BAFC 33722). SAN LUIS: Merlo, on *Lithraea ternifolia*, leg. C. Urcelay, XI-1998 (BAFC ex CORD). URUGUAY: DPTO. LAVALLEJA: Establecimiento “Santa Clara”, on living *Lithraea* sp., leg. S. Simeto & S. Martínez, 5-XI-2003 (MVHC 5302, 5303).

Remarks: This is the first record of *I. ochroporus* for Uruguay. *I. ochroporus* is similar to *I. patouillardii*, also present in Uruguay, but this last species has smaller spores measuring 5,0-7,0 x 3,5-5,0 µm (Gilbertson & Ryvarden 1987). *I. ochroporus* is also reminiscent of *I. quercustris* M Blackw. & Gilb. The holotype of *I. quercustris* (M. Blackwell 1511 from BPI) differs in having slightly larger spores, absence of hymenial setae, and presence of conspicuous contextual hyphae with irregular wall thickening (see also Blackwell & Gilbertson 1985).

Inonotus venezuelicus Ryvarden, Mycotaxon 28: 529. 1987.

SPECIMEN EXAMINED: VENEZUELA. EDO. MÉRIDA: Laguna Negra, E. of Laguna Mucubaji, Parq. Nac. Sierra Nevada, near Apartaderos, on *Polylepis* sp., leg. K.P. Dumont, J.H. Haines, G.J. Samuels & A. Revas (Dumont-VE 2300), det. L. Ryvarden, 18-VII-1971 (isotype NY).

Remarks: A complete description of this species is available in Ryvarden (1987, 2004). *Inonotus venezuelicus* was treated as a synonym of *I. jamaicensis* by Gottlieb et al. (2002). The isotype is a resupinate specimen, and although Ryvarden (1987, 2004) indicated the spore dimensions as 5,0-6,0 x 4,5-5,0 µm, my measurements (n=30) are 5,8-7,5 x 4,6-5,8 µm, slightly larger than those of *I. jamaicensis*. Thus, I believe this is a distinct species in the complex. Since only the type material is known, additional collections are needed to better characterize this species.

Key to the known species of *Inocutis* and *Inonotus* in Uruguay

- 1a. Setae present in context and hymenium, granular core and sclerified hyphae absent (*Inonotus*) 2
- 1b. Setae lacking in context and hymenium, rudimentary granular core with sclerified hyphae present (*Inocutis*) 4
- 2a. (1a) Chlamydospores present, basidiospores 6–8 x 4,5–7 µm *Inonotus rickii*
- 2b. (1a) Chlamydospores absent 3
- 3a. (2b) Basidiospores ovoid 7,5–9,0 x 5,5–7,0 µm *Inonotus ochroporus*
- 3b. (2b) Basidiospores ellipsoid 5,0–7,0 x 3,5–5,0 µm *Inonotus patouillardii*
- 4a. (1b) Basidiocarps effusse-reflexed to triquetrous, basidiospores 5,5–7,0 x 4–5 µm *Inocutis jamaicensis*
- 4b. (1b) Basidiocarps dimidiate to unguulate, basidiospores 8,0–9,0 x 6,0–7,0 µm *Inocutis texana*

Discussion

The genus *Inonotus* s.l. is poorly known in Uruguay with only two common species—*I. rickii* and *I. patouillardii*—reported for the country until recently/now. The genus has gained importance due to the great economic losses suffered by commercial *Eucalyptus* forests recently shown to be caused by *Inocutis jamaicensis* (Martínez 2005). The current intensive search to identify other species of *Inonotus* s.l. producing stem or wood rot of native or introduced trees of economic importance resulted in two new records for Uruguay: *Inonotus ochroporus* and *Inocutis texana*.

The genus *Inocutis* is well supported in molecular phylogenetic studies (Wagner & Fischer 2002, Gottlieb et al. 2002). Morphologically, the genus is characterized by sclerified hyphae in the context and a contextual granular core (although these structures were not observed in all the specimens studied) (Wagner & Fischer 2002). The genus also has a characteristic pigment pattern (Fiasson 1982).

This work reports for the first time the presence of sclerified hyphae in *I. jamaicensis*. Gilbertson & Ryvarden (1986) previously reported sclerified hyphae in *I. texana*. Because of its similarity to *I. jamaicensis* and the *Inocutis rheades* group, including the absence of setae, presence of a rudimentary granular core, presence of sclerified hyphae in the granular core and type of basidiospores, *I. texanus* is here transferred to *Inocutis*.

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A new species and a new record of smut fungi from Northwestern China

SHENGRONG WANG¹ & CUIYUN ZENG²

¹ wangsr@gsau.edu.cn & ² zengcy@st.gsau.edu.cn

Department of Plant Pathology, College of Grassland
Gansu Agricultural University, Lanzhou 730070, China

Abstract—A new species, *Thecaphora oxytropis* on *Oxytropis ochrocephala*, and a new record, *Urocystis irregularis* on a new host plant, *Aconitum carmichaelii*, are reported from Northwestern China.

Key words—*Ustilaginales*, taxonomy

During a mycological expedition to Tianzhu County of Gansu Province in Northwestern China in 2005, several interesting smut fungi were collected. Among them the authors identified a previously unknown species of *Thecaphora* on *Oxytropis ochrocephala*. According to Vánky (1991), eleven species of *Thecaphora* have been reported on *Leguminosae* world wide. None of them is on *Oxytropis*.

The authors compared the spore balls of the unknown *Thecaphora* sp. with those of other known species of *Thecaphora* on *Leguminosae*. Because no smut fungus known on *Leguminosae* has spore balls similar to those found on *Oxytropis ochrocephala*, we conclude that *Thecaphora* sp. on *Oxytropis* is a new species, and describe it as follows:

Thecaphora oxytropis S.R. Wang, sp. nov.

Figs. 1–3

Sori in seminibus transformatis, in locum massa glomerulorum sporarum colore pallide-brunnea, granuloso-pulverea substituens. Glomeruli sporarum globosi, ellipsoidei vel leviter irregulares, 32.5–47.5 × 38.0–54.5 µm, e sporis 4–21(–31) sat laxe connectis compositi. Sporae subpolyhedraliter irregulares, cuneiformis usque ellipsoidei, 16.5–22.0 × 14.0–17.0µm, pallide brunneas, pariete in locis contactus levi, in locis liberibus superficiei rotundato et verrucoso.

Sori in seeds filling the pods with a light-brown, granular-powdery mass of spore balls. Spore balls globose, subglobose, ovoid, ellipsoidal or slightly irregular, 32.5–47.5 × 38.0–54.5 µm, composed of 4–21(–31) easily separating ustilospores. Ustilospores subpolyhedral, cuneiform, ovoid, ellipsoidal, polyhedral or slightly irregular, 16.5–22.0 × 14.0–17.0µm, yellowish to light yellowish-brown, wall smooth on the contact surfaces, coarsely and irregularly verrucose on the free surface. Germination unknown.

On *Oxytropis ochrocephala* Bunge (*Leguminosae*), China, Gansu: Tianzhu County, Zhuaxi, alt. ca. 3100 m, 20 VIII 2005, coll. S.R. Wang & C.Y. Zeng, GAU 05011 (holotypus), HUV 21285 (isotypus). Known only from the type collection.

Thecaphora oxytropis and *T. hedysari* Vánky have loose spore balls, but they differ in that the former has smaller spore balls and fewer spores in a ball.

A species of *Urocystis* on *Aconitum carmichaelii* was also collected by the authors. After examination it turned out to be *Urocystis irregularis*. According to Vánky (1994), on *Aconitum* only one species of *Urocystis* is known, *U. irregularis*, occurring in Europe, Asia, and North America. It has not yet been reported from China nor anywhere previously on *A. carmichaelii* (Ling 1953, Guo 2000a,b, 2003, Guo & Zhang 2004, Guo & Wang 2005, Wang & Piepenbring 2002, Wang & Guo 2002, Vánky & Guo 1985, Kakishima et al. 2000). Thus, the collection represents a new record for China on a new host plant:

Urocystis irregularis (G. Winter) Săvul. Bul. Şti. Acad. Rep. Populare Române 3:220, 1951. **Figs.4-6**

= *U. sorosporioides* f. *irregularis* G. Winter, Hedwigia 19:2, 1880.

Sori on the abaxial side of leaves, on petioles and stems forming pustules, sometimes confluent, or in the veins as long swellings, at first covered by the epidermis subsequently rupturing to expose the black, powdery mass of spore balls. Spore balls subglobose to irregular, 26.0-37.5 × 21.0-28.5 µm in diam., composed of 1-6 ustilospores, surrounded by an incomplete layer of peripheral sterile cells. Spores subglobose, elongated, irregular to slightly polyhedral, 13.5-18.0 × 9.5-13.0 µm in diam., olive-brown to yellowish-brown, smooth or slightly granular, with irregular small thickenings on the free surface. Sterile cells globose, subglobose, ovoid to irregular, 8.5-12.0 × 4.0-8.5 µm, light yellowish-brown, smooth, hyaline.

On *Aconitum carmichaelii* Debeaux (*Ranunculaceae*), China, Gansu: Tianzhu County, Tanshanling, alt. ca. 2890 m, 18 VIII 2005, coll. S.R. Wang & C.Y. Zeng. GAU 05015.

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Figs. 1-3. *Thecaphora oxytropis* on *Oxytropis achrocephala* (holotypus). Fig. 1. Spore balls as seen by LM (light microscopy); Fig. 2. Spore balls as seen by SEM (scanning electron microscopy). Fig. 3. Spore ball as seen by SEM. Figs. 4-6. *Urocystis irregularis* on *Aconitum carmichaelii* (GAU 05015). Fig. 4. Spore balls as seen by LM. Fig. 5. Spore balls as seen by SEM. Fig. 6. A spore ball as seen by SEM
Bars = 10 µm

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Additional and interesting lichenized and lichenicolous fungi from Turkey

MEHMET GÖKHAN HALICI¹

mghalici@erciyes.edu.tr

*Biology Department, Faculty of Science & Art, Erciyes University
Kayseri, Turkey*

MUSTAFA KOCAKAYA

kocakaya38@mynet.com

*Ahmet Gazi Ayhan Bulvarı, Kazımkarabekir Mah
Silvan Geçidi No:24 Kayseri, Turkey*

AHMET AKSOY

aksoy@erciyes.edu.tr

*Biology Department, Faculty of Science & Art, Erciyes University
Kayseri, Turkey*

Abstract—14 species of lichenized and lichenicolous fungi are reported from the Turkish provinces of Kayseri, Niğde, Adana, Yozgat and Muğla. Nine taxa, *Anisomeridium viridescens*, *Cercidospora epicarphinea*, *Lichenodiplis lecanorae*, *Lichenothelia convexa*, *Pilophorus cereolus*, *Porpidia superba*, *Sagediopsis campsteriana*, *Toninia verrucarioides* and *Zwackhiomyces sphinctrinoides* are new for Turkey. Comments on habitat and substrata and a short description are provided for each taxon.

Key words—Ascomycota, conidial fungi, lichens

Introduction

Serious lichenology in Turkey started in last two decades. A total of 360 papers actually refer to lichens from Turkey (John 2004). If floristic, these mostly focus on the lichens of the Black Sea region (e.g. John & Breuss 2004, Yıldız et al. 2002, Yazıcı 1999, Özdemir Türk 1997) and the Mediterranean region (e.g. John 2003, John & Nimis 1998, Nimis & John 1998, John, 1996), but there have been few lichenological studies in Central Anatolia (e.g. Halıcı et al. 2005, Karabulut & Türk 1998, Özdemir 1991). This contribution reports further species as first records for Turkey or the province of Kayseri, Muğla or Yozgat.

Materials and Methods

The specimens on which this paper is based are all preserved in the herbarium of Erciyes University, Biology Department, Science & Art Faculty, Kayseri, Turkey. The accession numbers of the collections are given in parentheses after the locality details.

The specimens were first examined with a dissecting microscope, and then with an Olympus BH2 microscope fitted with Nomarski differential interference contrast. Specimens were examined in water, 10% KOH, Lugols iodine solution or lactofuchsin. Spore measurements were generally made in KOH, but in the case of thin walled spores these were also checked in water.

Species recorded

Anisomeridium viridescens (Coppins) R.C. Harris

A detailed description is provided by Purvis et al. (1992: 92, as *Arthopyrenia viridescens*).

The Turkish specimen was collected from bark of *Cedrus libani* associated with *Caloplaca cerina* var. *cerina* and *C. flavorubescens* in ancient woodland. The thallus is lichenized with *Trentopohlia*. Ascomata are perithecia, involucrellum brown, K + green. Asci 8-spored. Ascospores colourless, 1-septate, the cells usually biguttulate, 12.5-14.5 x 4-5 µm.

New record for Turkey. Known also from the British Isles on smooth bark of *Corylus* in old woodlands (Purvis et al. 1992).

KAYSERİ: Yahyalı, Aladağlar Milli Parkı, Hacer Ormanları, 37° 48.152' N, 35° 16.870' E, alt. 1690 m, on bark of *Cedrus libani*, 20 Sep.2004, leg. M. G. Halıcı & A. Aksoy, det. D. L. Hawksworth (MGH 0.2275).

Bacidia laurocerasi (Delise ex Duby) Zahlbr.

A detailed description is provided by Purvis et al. (1992: 107).

The Turkish specimen was collected from the bark of *Pinus nigra* growing with macrolichens such as *Anaptychia ciliaris*, *Bryoria fuscescens* and *Parmeliopsis ambigua* in ancient woodland. Thallus very thin. Apothecia ~ 1 mm; numerous, blackish. Asci 8-spored. Ascospores 30-38 x 3-4 µm, 8- to 13-septate at maturity, acicular.

In Turkey, previously recorded from Muğla (John 1996, Nimis & John 1998) and Sakarya (Szatala 1927 as *B. endoleuca*). New record for Kayseri province.

Known also from the British Isles, Europe, North America, Australia and New Zealand on ± basic or nutrient rich bark of trunks and branches of trees and shrubs, usually in open situations or secondary woodland (Purvis et al. 1992).

KAYSERİ: Yahyalı, Aladağlar Milli Parkı, Hacer Ormanları, 37° 47.935' N, 35° 18.136' E, alt. 1648 m, on bark of *Pinus nigra*, 20 Sep.2004, leg. M. G. Halıcı & A. Aksoy, det. D. L. Hawksworth (MGH 0.2276).

Buellia erubescens Arnold

A detailed description is provided by Purvis et al. (1992: 113).

The Turkish specimen, collected from ± smooth bark of *Abies* in ancient woodland, was associated with *Parmelina pastillifera*, *Anaptychia ciliaris* and *Lecidella elaeochroma*. Thallus thin; whitish, K + red, PD + orange, C -. Apothecia ~ 1 mm, heavily pruinose when young. Asci 8-spored. Ascospores first colourless, then brown, 2-celled; 12.5-15 x 5.6-7.5 µm.

Previously recorded from six provinces in Turkey (John & Nimis 1998, Huneck et al. 1992, Yıldız & John 2002, John & Breuss 2004, Steiner 1909, Özdemir 1990), sometimes as *B. zahlbruckneri*. New record for Kayseri province.

Known also from the British Isles, western and central Europe, the Azores and North America, on $\pm$ smooth bark (Purvis et al. 1992).

KAYSERİ: Yahyalı, Aladağlar Milli Parkı, Hacer Ormanları, 37° 47.935' N, 35° 18.136' E, alt. 1648 m, on bark of *Abies*, 20 Sep.2004, leg. M. G. Halıcı & A. Aksoy, det. D. L. Hawksworth (MGH 0.2277).

Cercidospora epicarphinea (Nyl.) Grube & Hafellner

A detailed description is provided by Grube & Hafellner (1990).

The Turkish specimen grows on the apothecia of an unidentified *Caloplaca* sp. and appears to suppress ascospore production in the host. Interascal tissues (hamathecium) present. Perithecia immersed, 150-180 μ m diam, peridial wall blue-green. Asci 8-spored. Ascospores 16.5-20 x 4.5-6 μ m, 1-septate, colourless.

New record for Turkey. Known also from Spain and Canary Islands on *Caloplaca carphinea* and *C. scoriophila* (Grube & Hafellner 1990).

KAYSERİ: Erciyes Mountain, Exit of Hisarcık, Western part of the highway, 38° 36' N, 35° 30' E, alt. 1540 m, on the apothecia of *Caloplaca* sp. on siliceous rocks, 25 Aug.2002, leg. M. G. Halıcı & M. Kocakaya, det. D. L. Hawksworth (MGH 0.2278).

Leptorhaphis atomaria (Ach.) Szatala

A detailed description is provided by Aguirre-Hudson (1991: 99).

The Turkish specimen, collected from the bark of *Populus nigra*, was associated with *Lecanora albella*. Thallus smooth, very thin; weakly lichenized with *Trentopohlia*. Asci 8-spored; ascospores arranged in two bundles in the asci, colourless, 1-septate, filiform, crescent shaped, 20-22 x 2.5-4 μ m.

Previously recorded from İstanbul by Steiner (1889). New record for Kayseri province.

Widespread in temperate regions of Europe on bark of *Fraxinus excelsior* and also particularly on species of *Populus*, growing on the trunk, often mixed with lichens such as *Xanthoria parietina* and species of *Caloplaca* and *Lecanora*; perhaps facultatively lichenized with trentepohlioid algae or not, it has also been mentioned from Northern America (Aguirre-Hudson 1991).

KAYSERİ: Yahyalı, Aladağlar Milli Parkı, Hacer Ormanları, 37° 47.935' N, 35° 18.136' E, alt. 1648 m, on bark of *Populus nigra*, 20 Sep.2004, leg. M. G. Halıcı & A. Aksoy, det. D. L. Hawksworth (MGH 0.2279).

Lichenodiplis lecanorae (Vouaux) Dyko & D. Hawksw.

A detailed description is provided by Hawksworth (1981).

The Turkish specimen, on the apothecia of *Caloplaca holocarpa*, was collected from the bark of *Populus nigra*; it seems to be commensalistic as there was no damage to the thallus, and ascospore production was not suppressed. Conidia pale brown to dark brown, arising singly, 1-septate, 4.5-5 x 2-2.5 μ m diam.

Commensalistic to parasitic on the apothecia, and more rarely the thalli, of *Caloplaca*, *Lecanora* and *Pertusaria* species, also on thalli of *Evernia prunastri*, *Lecidea erratica* and *Schismatomma decolorans*.

New record for Turkey. Widespread in Europe, the former U.S.S.R, and also known from Morocco (Hawksworth 1981).

KAYSERİ: Yahyalı, Aladağlar Milli Parkı, Hacer Ormanları, 37° 47.906' N, 35° 17.889' E, alt. 1595 m, on the apothecia of *Caloplaca holocarpa* on bark of *Populus nigra*, leg. M. G. Halıcı & A. Aksoy, det. D. L. Hawksworth, (MGH 0.2280).

Lichenostigma maureri Hafellner

A detailed description is provided by Hafellner (1982).

The Turkish specimens, on *Usnea subfloridana* and *Pseudevernia furfuracea*, were collected from *Pinus sylvestris*. Commensalistic, since no damage observed in the host thallus. Ascomata internal structure paraplectenchymatic stromatic, non-aggregated. Ascospores brown, echinulate, upper cell wider; 10 x 5 µm.

Previously recorded from Turkey by Hafellner (1982). New record for Muğla and Yozgat provinces.

Known also from Spain, the Canary Islands and Great Britain on *Usnea* species and *Pseudevernia furfuracea* (Hafellner 1982, Hawksworth 1982).

MUĞLA: Yaraş Village, Picnic Area of Yaraş Forest (20 km to the city center), 37° 09.128' N, 28° 29.918' E, alt. 750 m, on *Pseudevernia furfuracea* on *Pinus sylvestris*, 23 Aug.2004, leg. M. G. Halıcı & M. Kocakaya, det. D. L. Hawksworth, (MGH 0.2289).

YOZGAT: Akdağmaden District, Between Büyük Nalbant Mountain and Kızılkoca Village, Çat Ormanları, 39° 30' N, 35° 59' E, alt. 1780 m, on *Usnea subfloridana* on *Pinus sylvestris*, leg. M. G. Halıcı & M. Kocakaya, det. D. L. Hawksworth, (MGH 0.2281).

Lichenothelia convexa Henssen

A detailed description is provided by Purvis et al. (1992: 359-360).

The Turkish specimen was collected from bare rock and sometimes on *Aspicilia caesiocinerea*. This material lacked ascospores, but has macroconidia, 10-20 µm diam., agreeing with those illustrated and described by Henssen (1987).

New record for Turkey. Known also from the British Isles, Germany, Sweden and North America on slate, intermixed with *Rhizocarpon geographicum* thalli, and on sarsens (Purvis et al., 1992).

ADANA: Aladağlar Milli Parkı, Turhasan Mountain, 37° 45.280' N, 35° 18.028' E, alt. 2000 m, on bare siliceous rocks and *Aspicilia caesiocinerea*, leg. M. G. Halıcı & A. Aksoy, det. D. L. Hawksworth, (MGH 0.2282).

Pilophorus cereolus (Ach.) Th.Fr.

Detailed descriptions are provided by Jahns (1981) and Brodo et al. (2001).

The Turkish specimen was collected on calcareous soil. Primary thallus greyish, sorediate. No apothecia. Thallus and soralia K + yellow, PD -.

New record for Turkey. Known also from many localities in Europe and North America on weathered rocks or soil (Jahns, 1981, Brodo et al. 2001).

NİĞDE: Çamardı, Aladağlar Milli Parkı, Entrance of Demirkazık, 37° 51.050' N, 35° 07.100' E, alt. 1900 m, on calcareous soil, 29 Aug.2005, leg. M. G. Halıcı & M. Kocakaya, det. D. L. Hawksworth, (MGH 0.2283).

***Porpidia superba* (Körb.) Hertel & Knoph**

A detailed description is provided by Gowan & Ahti (1993: 69).

The Turkish specimen was collected from calcareous rocks. Thallus cream-white, thick, forming knob-like bullae, K-, C-. Apothecial disks brown, concave, heavily pruinose. True exciple well developed, black. Asci 8-spored. Ascospores colourless, simple; 15-22 x 9-10 µm.

New record for Turkey. Known also from Finland, Great Britain and Russia on calcareous and also on siliceous rocks, particularly schists (Gowan & Ahti 1993).

KAYSERİ: Yahyalı, Aladağlar Milli Parkı, Delikkaya, 37° 54.948' N, 35° 15.506' E, alt. 2910 m, on calcareous rock, 3 Oct.2004, leg. M. G. Halıcı & A. Aksoy, det. D. L. Hawksworth, (MGH 0.2284).

***Rhizocarpon simillimum* (Anzi) Lettau**

A detailed description is provided by Purvis et al. (1992: 541).

The Turkish specimen was collected from siliceous rocks. Thallus dark grey, areolate; areoles bullate. Asci 8-spored, ascospores brown, 1-septate; 12-13 x 6-7 µm.

In Turkey, previously recorded from Mudanya (Verseghy 1982). New record for Kayseri province.

Known also from the British Isles and Norway on sunny, acid, ± vertical outcrops (Purvis et al. 1992).

KAYSERİ: Erciyes Mountain, North of Perikartın (Northern slope of Erciyes Mountain), 38° 35' N, 35° 27' E, alt. 2300 m, on siliceous rock, 3 Oct.2004, leg. M. G. Halıcı & M. Kocakaya, det. D. L. Hawksworth, (MGH 0.2285).

***Sagediopsis campsteriana* (Linds.) D. Hawksw. & R. Sant.**

A detailed description is provided by Triebel (1993).

The Turkish specimen, on *Aspicilia desertorum*, was collected from calcareous rocks. Ascromata perithecia, arising singly, immersed at the base and appearing largely superficial, black, not shiny, 100-250 µm diam; ostiolate, the ostiole not papilliform or raised in any way. Asci elongate-clavate, bitunicate in structure, discharge not seen, thickened at the apex, about 65-70 x 11-13 µm, 8-spored. Ascospores overlapping and distichously arranged in the ascus, broadly fusiform, apices generally somewhat attenuated towards the apices but occasionally more rounded, colourless, (1-)3-septate, not constricted at the septum, the cells often with conspicuous rounded vacuoles, smooth walled, lacking a defined gelatinous sheath, 12-21 x 4.5-7 µm, l/b ratio 2-3.5.

New record for Turkey. Known also from Europe and North America on several *Ochrolechia* species and *Lecanora hagenii* (Triebel 1993).

KAYSERİ: Yahyalı, Aladağlar Milli Parkı, Gökoluk Mevkii, Dedegediği geçidi, 37° 55.392' N, 35° 17.376' E, alt. 2430 m, on *Aspicilia desertorum* on calcareous rocks, 2 Aug.2005, leg. M. G. Halıcı & A. Aksoy, det. D. L. Hawksworth, (MGH 0.2286).

Toninia verrucarioides (Nyl.) Timdal

A detailed description is provided by Timdal (1991: 117).

The Turkish specimen was collected from calcareous rocks in a shaded habitat in a forest. Thallus squamulose. Asci 8-spored. Ascospores colourless, ellipsoid to bacilliform, 1- to 3-septate; 9.5-15 x 4-5 µm.

New record for Turkey. Known from temperate and arctic parts of Europe and North America on calciferous rocks, usually in fissures but also on smooth faces or on soil-covered rock (Timdal 1991).

MUĞLA: Yaraş Village, Picnic Area of Yaraş Forest (20 km to the city center), 37° 09.128' N, 28° 29.918' E, alt. 750 m, on calcareous rock, 23 Aug.2004, leg. M. G. Halıcı & M. Kocakaya, det. D. L. Hawksworth, (MGH 0.2287).

Zwackhiomyces sphinctrinoides (Zwackh) Grube & Hafellner

A detailed description is provided by Grube & Hafellner (1990).

The Turkish specimen, on *Xanthoria elegans*, was collected from calcareous rocks. Ascomata perithecia; pyriform, 150-250(-270) µm diam; peridial wall brown with basal cells paler than the upper ones. Asci 8- spored. Ascospores colourless, 1-septate, verruculose, 18-20 x 6.5-9 µm.

New record for Turkey. Widespread in Great Britain and Spain on *Collema* species, *Clauzadea metzleri*, *Leptogium turgidum*, *Caloplaca variabilis*, *Solenopsora olivacea* and other calcicolous lichens (Grube & Hafellner 1990).

KAYSERİ: Yahyalı, Aladağlar Milli Parkı, Gökoluk Mevkii, Dedegediği geçidi, 37° 55.392' N, 35° 17.376' E, alt. 2430 m, on *Xanthoria elegans* on calcareous rocks, leg. M. G. Halıcı & A. Aksoy, det. D. L. Hawksworth, (MGH 0.2286).

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Four species of *Exobasidium* from Korea

JI-HYUN PARK¹, KYUNG-HEE KIM^{2*},
KYUNG-JOON LEE¹ & SEUNG-KYU LEE²

¹Department of Forest Sciences, Seoul National University
Seoul 151-921, Korea

*kyung624@foa.go.kr

²Department of Forest Environment, Korea Forest Research Institute
Seoul 130-712, Korea

Abstract—Four species of *Exobasidium* collected in Korea are reported with descriptions and host plants. They are *E. dubium*, *E. yoshinagai*, *E. japonicum* and *E. cylindrosporium*. Of these, *E. dubium*, *E. yoshinagai* and *E. cylindrosporium* are newly added to the fungus flora of Korea.

Key words—*Exobasidium* diseases, *Rhododendron*

Introduction

The genus *Exobasidium* belongs to Basidiomycota and contains more than 100 described taxa (Alexopoulos et al. 1996, Nagao et al. 2004a). They are all plant pathogens causing leaf galls, blight, blisters, witches' broom, dwarfing or abnormal bud proliferation in field trees and ornamentals (Coyier & Roane 1986; Ing 1998, 1999). The fungus flora in Korea is still very poorly known and has not been investigated in many regions of the country. In some phytopathological papers (cf. Korean Society of Plant Pathology 2004), two *Exobasidium* species parasitic on three host plants were listed and additional one unidentified species was recorded to be associated with leaf galls on *Rhododendron schlippenbachii*. Therefore, mycological studies for the Korean *Exobasidium* spp. are urgently needed for diagnosis of the diseases and precise identification of the fungus. In the present paper we described morphological characteristics and host plants of four *Exobasidium* species based on specimens collected in Korea.

Materials and Methods

The materials listed in the present paper were collected from May to June, 2004 and were deposited in KFRI (Korea Forest Research Institute). Identification of each fungus was based on microscopic as well as cultural characteristics. Leaves with newly sporulating lesions were cut into small pieces and fixed to the inside of the lid of a

*Corresponding author.

sterile Petri dish, poured with potato dextrose agar (PDA) acidified with 10% (v/v) lactic acid. The dish was kept at 23°C in the dark. The lid of the Petri dish was turned at two hours intervals. Basidiospores then fell down from the hymenium onto the agar surface. After microscopic examination, basidiospore was isolated from the dish, and 18 isolates were transferred to new PDA dishes for further growth. The cultures were incubated in an unlighted room at 23°C. Slides were prepared on Shear's mounting fluid for morphological observation under light microscope. JSM-5410LV SEM was used for the observation of basidia and sterigmata. Additional anatomical observations using paraffin infiltration method were conducted to study the comparative anatomy of infected areas by *Exobasidium* species. Ezuka (1974a, b, 1990a, b, 1991a, b, 1992a, b, c), Ito (1955), Karatygin (2000), Karatygin & Huseyin (2002), Nannfeldt (1981), Nagao et al. (2001, 2003a, b, 2004a, b), Otani (1976), Sundström (1964) and Zhang et al. (1995) were consulted to aid in species identification.

Descriptions

1. *Exobasidium dubium* Racib., Kosmos 34: 1172 (1909).

Fig. 1

DESCRIPTION: Germ tubes of the basidiospores emergent from both end cells at first then from each septal regions; conidia produced at the tip of germ tubes or laterally, budding to produce daughter cells polarly, developing into hyphae; colonies on PDA growing gradually, to a maximum 7 mm diam. in 21-day incubations, gelatinous, fixed on the agar surface, composed of branching and intricate hyphae, pseudohyphae and conidia; surface yellowish white to pale yellow, corrugate in center, not farinose by conidial formation; dark pigmentation absent.

Basidia 17-31 x 5.5-10.0 µm, clavate to cylindrical, apices obtuse, (2-)3-4(-5)-spored, directly emergent from the host surface or through stomata, not fasciculate; sterigmata 3-7 µm long, 1.5-2.0 µm diam. at the base, outwardly emergent, tapering toward the tip; basidiospores 13-23 x 3.3-8.0 µm, subcylindric to musiform, straight to slightly curved, becoming slender in center and septal regions, hyaline, smooth, unicellular when formed, becoming 1-4(-5)-septate when germinating; conidia 5-15 x 1.3-3.6 µm, linear, acicular, sometimes 1-septate.

SYMPTOMATIC CHARACTERISTICS: Flat lesions on leaves, up to 15 mm across, usually 1 to 5 lesions on one leaf, circular to irregular in outline, sometimes confluent to develop larger, pale yellow to yellow above, becoming reddish or brownish in center, sometimes with conspicuous red margin above; the lower leaf surface of the infected area eventually with a thin white layer of hymenium; mycelial mat localized between the lower epidermis and the first layer of spongy mesophyll; infected parts not thickened; hypertrophy and hyperplasia absent.

HABITAT: On living leaves of *Rhododendron yedoense* f. *poukhanense* (H. Lév.) M. Sugim. and *R. yedoense* Maxim. f. *yedoense*.

SPECIMENS EXAMINED: On *R. y. f. poukhanense*, KFRI2237, 2238, 2239, 2240, 2241, 2242 (3 June, 2004, Seoul), KFRI2243, 2244, 2245, 2246 (5 June, 2004, Pocheon-si), KFRI2247 (24 June, 2004, Seoul); On *R. y. f. yedoense*, KFRI2248 (3 June, 2004, Seoul), KFRI2249 (24 June, 2004, Seoul).

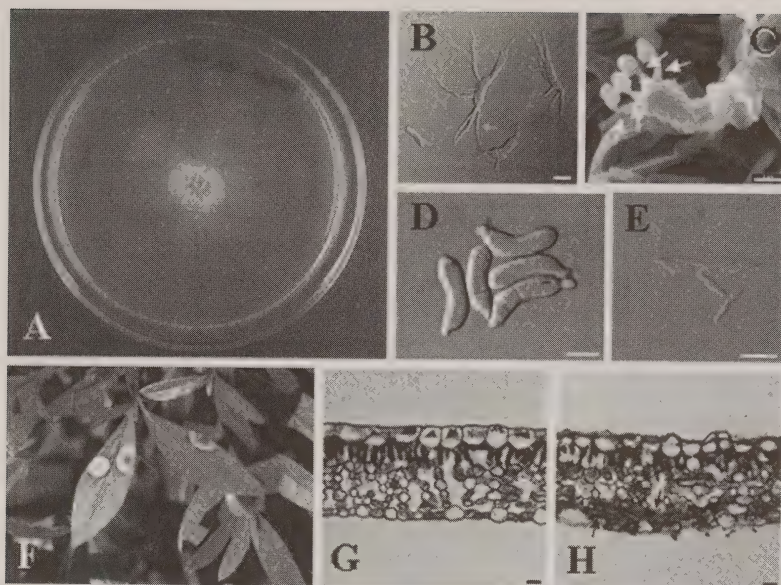


Fig. 1. *Exobasidium dubium*. A. A colony on PDA, 16 weeks, KFRI2244. B. Germination of basidiospores on PDA, Arrow shows a long germ tube, KFRI2237. C. A basidium with four immature basidiospores, Arrows show sterigmata, KFRI 2243. D. Three basidiospores before septation and two spores becoming 3-septate, KFRI2249. E. Conidia, KFRI2249. F. Flat lesions with conspicuous red margin on adaxial leaf surface in a naturally infected host. G. A cross section of healthy part of infected leaf, KFRI2249. H. A cross section of infected part, Arrows show mycelial mats in abaxial side, KFRI2249. Scale bars: B = 10 μ m, C = 5 μ m, D–E = 10 μ m, G–H = 20 μ m.

NOTES: This is the first record on this species in Korea. This fungus was recorded on *R. luteum* from Europe and on *Rhododendron* sp. from Turkey (Nannfeldt 1981, Karatygin & Huseyin 2002). Recently, Nagao et al. (2003a) discussed this fungus on leaves of *R. y. f. yedoense* in Japan. The present study adds *R. y. f. poukhanense* and *R. y. f. yedoense* as new host records to Korea. Although the Korean specimens did not show colonies with pale pink described by Nagao et al. (2003a), the other taxonomic characteristics of this species are in close agreement with the previous records.

2. *Exobasidium yoshinagai* Henn., Bot. Jahrb. 31: 736 (1902).

Fig. 2

DESCRIPTION: Germ tubes of the basidiospores emergent from each cell, developing into long and branched hyphae; conidia produced at the tip of germ tubes or laterally, budding to produce daughter cells polarly, developing into hyphae; colonies on PDA growing gradually, to a maximum 4 mm diam. in 21-day incubations, gelatinous, fixed on the agar surface, composed of branching and intricate hyphae, pseudohyphae and conidia; surface yellowish white, slightly corrugate in center, not farinose by conidial formation; dark pigmentation absent.

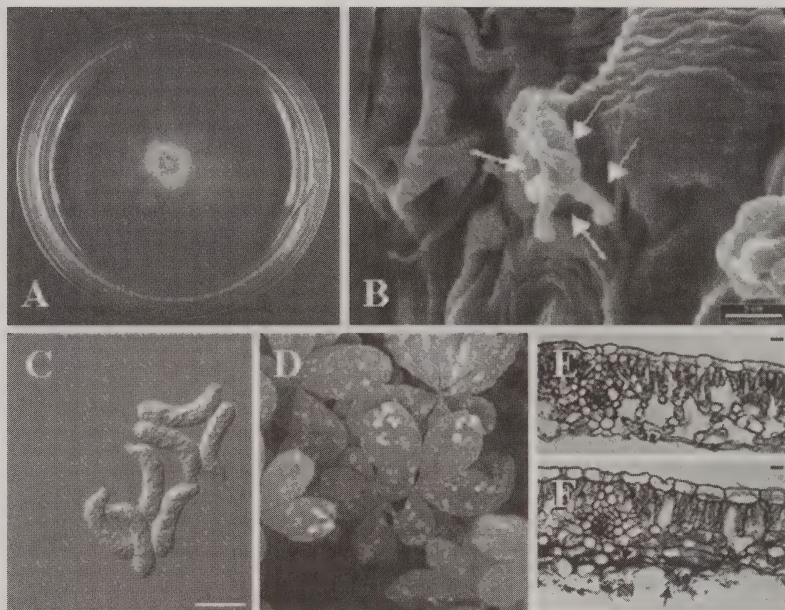


Fig. 2. *Exobasidium yoshinagai*. A. A colony on PDA, 16 weeks, KFRI2250. B. A basidium with four immature basidiospores, Arrows show sterigmata, KFRI2252. C. Strongly geniculate basidiospores towards the hilum before septation, KFRI2252. D. Flat lesions without conspicuous red margin on adaxial leaf surface in a naturally infected host. E. A cross section of healthy part of infected leaf, KFRI2250. F. A cross section of infected part, Arrows show mycelial mats in abaxial side, KFRI2250. Scale bars: B = 5 μ m, C = 10 μ m, E-F = 20 μ m.

Basidia 20-34 x 5.4-9.1 μ m, clavate to cylindrical, apices obtuse, 2-4-spored, directly emergent from the host surface or through stomata, not fasciculate; sterigmata 3-8 μ m long, 1.5-2.1 μ m diam. at the base, outwardly emergent, tapering toward the tip; basidiospores 13-22 x 4.2-6.5 μ m, cylindrical, slightly curved, strongly geniculate towards the hilum, hyaline, smooth, unicellular when formed, becoming (1-)3-septate when germinating; conidia 5-10 x 1.4-2.9 μ m, linear to acicular.

SYMPTOMATIC CHARACTERISTICS: Flat lesions on leaves, up to 49 lesions under 5 mm across on one leaf, sometimes 1 to 4 lesions ranging from 7 to 14 mm across on one leaf, circular in outline, sometimes confluent to develop larger, pale yellow to yellow above, without conspicuous margin above; the lower leaf surface of the infected area eventually with a thin white layer of hymenium; mycelial mats localized in the abaxial side of the lesions; infected parts not thickened; hypertrophy and hyperplasia absent.

HABITAT: On living leaves of *Rhododendron schlippenbachii* Maxim.

SPECIMENS EXAMINED: On *R. schlippenbachii*, KFRI2250, 2251 (3 June, 2004, Seoul), KFRI2252 (5 June, 2004, Pocheon-si).

NOTES: Earlier literature (Ezuka 1991a) gave relatively long measurements of basidia, in the range of 50-70 μm . In the Korean materials, they are much shorter (20-34 μm). It may be due to the different criteria for measurement of the length of basidia that develop from mycelium beneath the epidermis. In addition, Ezuka (1991a) commented that the number of leaf lesions by this fungus was under ten on one leaf, but *E. yoshinagai* was occasionally found to form abundant small lesions (under 5 mm) on one leaf of *R. schlippenbachii* in this study. The other characteristics of taxonomic value match well each other. This is the first record on the fungus in Korea. Ezuka (1974a, 1991a) reported this species as a causal agent of the leaf blisters of *R. dilatatum*, *R. kiyosumense*, *R. reticulatum*, *R. wadanum*, *R. viscistylum* var. *glaucum* and *R. weyrichii* from Japan. *Rhododendron schlippenbachii* was recognized as a new host record to Korea.

3. *Exobasidium japonicum* Shirai, Bot. Mag. Tokyo 10: 52-53 (1896).

Fig. 3

DESCRIPTION: Germ tubes of the basidiospores emergent from both polar cells, sometimes from septal regions; conidia produced at the tip of germ tubes or laterally, budding to produce daughter cells polarly, developing into hyphae; colonies on PDA growing gradually, to a maximum 8 mm diam. in 21-day incubations, sometimes heaping up to form a mound, gelatinous, fixed on the agar surface, composed of branching and intricate hyphae, pseudohyphae and conidia; surface pastel yellow to pale yellow but sometimes pale orange or pale red to greyish red, slightly corrugate around the center, sometimes farinose by conidial formation; sometimes dark pigmentation present.

Basidia 29-50 x 3.5-8.5 μm , clavate to cylindrical, apices obtuse, 2-4-spored, directly emergent from the host surface or through stomata; sterigmata 3-7 μm long, 1.5-3.0 μm diam. at the base, outwardly emergent, tapering toward the tip; basidiospores 10-19 x 3.0-5.9 μm , musiform, straight to slightly curved, hyaline, smooth, unicellular when formed, becoming 1(-2)-septate when germinating; conidia 6-15 x 1.2-2.0 μm , linear.

SYMPTOMATIC CHARACTERISTICS: Pocket like depressions in leaves, concave above and convex below, 1 to 5 galls on one leaf, sometimes covering the entire leaf, light green above, sometimes becoming reddish; both adaxial surface and abaxial surface of the infected area eventually covered with white powdery hymenium; mycelial mats located under both epidermal layers; infected parts 2-9 times thicker than healthy parts; hypertrophy and hyperplasia occurred; cell differentiation absent in the infected tissues except for the epidermis and vascular bundle; cell contents lost in the infected parts.

HABITAT: On living leaves of *Rhododendron yedoense* f. *poukhanense* and *R. yedoense* f. *yedoense*.

SPECIMENS EXAMINED: On *R. y. f. poukhanense*, KFRI2253, 2254, 2255 (3 June, 2004, Seoul), KFRI2256 (5 June, 2004, Pocheon-si); On *R. y. f. yedoense*, KFRI2257, 2258 (3 June, 2004, Seoul), KFRI2259 (5 June, 2004, Pocheon-si), KFRI2260 (24 June, 2004, Seoul).

NOTES: Chung et al. (1977) and Korean Society of Plant Protection (1986) listed this fungus in Korea without morphological description on *R. schlippenbachii* and *R. mucronulatum*, respectively. However, *R. schlippenbachii* and *R. mucronulatum* have wrongly been identified as hosts of *E. japonicum* instead of *R. y. f. poukhanense* in Korea. There is no *Exobasidium* species causing such pocket-like leaf galls on those species and

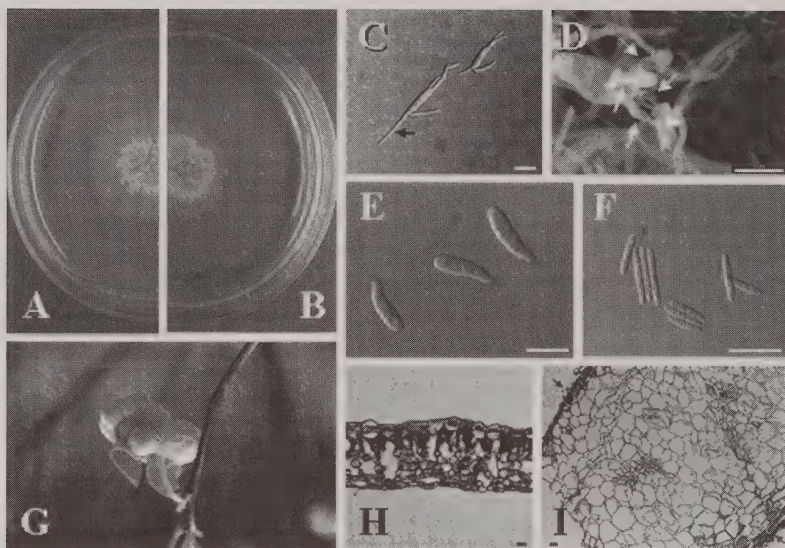


Fig. 3. *Exobasidium japonicum*. A. A colony on PDA, 16 weeks, KFRI2256. B. A colony on PDA exuding dark pigment, 16 weeks, KFRI2260. C. Basidiospore germination of mycelial type on PDA, Arrow shows a long germ tube, KFRI2255. D. A Basidium with four immature basidiospores, Arrows show sterigmata, KFRI2260. E. Musiform basidiospores before septation, KFRI2256. F. Conidia, KFRI2256. G. Pocket-like depressions on a naturally infected host. H. A cross section of healthy part of infected leaf, KFRI2260. I. A cross section of infected part with hypertrophy and hyperplasia, Arrows show mycelial mats in both adaxial and abaxial sides, KFRI2260.

Scale bars: C = 10 μ m, D = 5 μ m, E–F = 10 μ m, H = 20 μ m, I = 40 μ m.

related sections, *Sciadorhodon* and *Rhodorastum*. Therefore, this fungus is considered as a new record in Korea. The Korean materials have shorter basidia than those of previous records (Ito 1955, Nannfeldt 1981, Ezuka 1990b). Nannfeldt (1981) commented that infected parts were eventually hymenium-clad and chalky white on the morphological underside. However, white hymenium-clad occurred on both sides of leaf galls in Ezuka's study and present study. The other characteristics of taxonomic value for this species are generally in agreement with the previous records. *R. indicum*, *R. kaempferi*, *R. lateritium*, *R. linearifolium*, *R. mucronatum*, *R. obtusum*, *R. pulchrum*, and *R. simsii* were reported from Japan and Europe (Ito 1955, Nannfeldt 1981, Ezuka 1990b). *R. y. f. poukhanense* and *R. y. f. yedoense* were recognized as new hosts to Korea.

4. *Exobasidium cylindrosporium* Ezuka, Trans. Mycol. Soc. Japan 31: 451 (1990). Fig. 4

DESCRIPTION: Germ tubes of the basidiospores emergent from each cell, small and short; conidia produced at the tip of germ tubes, budding to produce daughter cells polarly; colonies on PDA growing gradually, to a maximum 11 mm diam. in 21-day incubations, gelatinous, fixed on the agar surface, composed of hyphae and conidia; surface white to orange white, corrugate narrowly around the center; dark pigmentation absent.

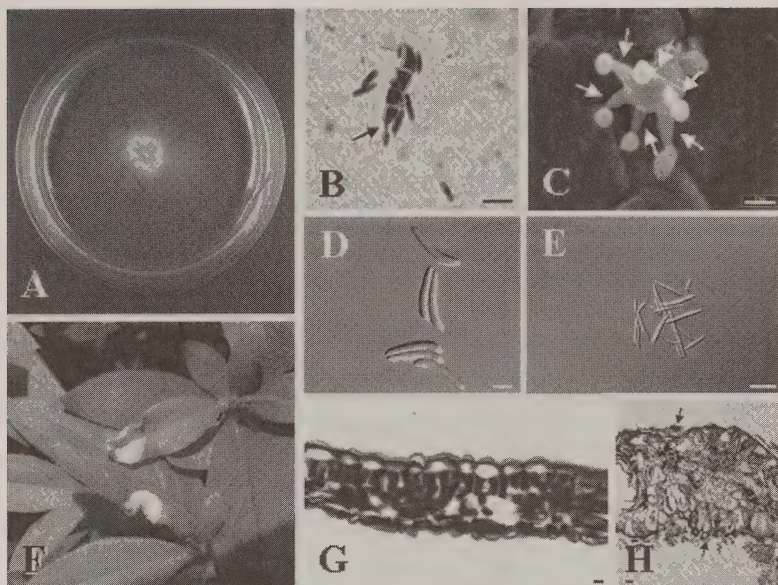


Fig. 4. *Exobasidium cylindrosporum*, KFRI2261. A. A colony on PDA, 16 weeks. B. Basidiospore germination of conidial type on PDA, Arrow shows a short germ tube. C. A basidium with six immature basidiospores, Arrows show sterigmata. D. Long and slenderly fusiform basidiospores before septation. E. Conidia. F. Shallow leaf depressions on a naturally infected host. G. A cross section of healthy part of infected leaf. H. A cross section of infected part in which hypertrophy without hyperplasia occurred, Arrows show mycelial mats in both adaxial and abaxial sides.

Scale bars: B = 10 μ m, C = 3 μ m, D = 10 μ m, E = 10 μ m, G–H = 20 μ m.

Basidia 20–36 x 5.0–6.9 μ m, clavate to cylindrical, apices obtuse, 4–6-spored, directly emergent from the host surface or through stomata; sterigmata 4–6 μ m long, 1.7–2.7 μ m diam. at the base, outwardly emergent, tapering toward the tip; basidiospores 19–24 x 2.9–4.8 μ m, slenderly and long cylindrical, slightly curved, hyaline, smooth, unicellular when formed, becoming 1–3-septate when germinating; conidia 7–21 x 1.7–2.6 μ m, linear.

SYMPTOMATIC CHARACTERISTICS: Shallow depressions on leaves, 4 to 11 mm diam. across, with red margin above, usually concave above and convex below, mostly circular in outline, sometimes confluent to develop larger and irregular distortion; 1 to 3 shallow depressions on one leaf; both adaxial and abaxial sides of leaf galls eventually covered with white powdery hymenium; mycelial mats concentrated under both epidermal layers; infected parts 3–7 times thicker than healthy parts; hypertrophy occurred without hyperplasia; cell differentiation absent in the infected tissues except for the epidermis and vascular bundle; cell contents lost in the infected parts.

HABITAT: On living leaves of *Rhododendron tashiroi* Maxim.

SPECIMENS EXAMINED: On *R. tashiroi*, KFRI2261 (16 June, 2004, Suwon-si).

NOTES: This is the first record on the fungus in Korea. The Korean collection is in general in accordance with the description by Ezuka (1990b) except for the basidia that were measured longer in the literature. This fungus was recorded from Japan on leaves of *R. hortense*, *R. macrosepalum*, *R. mucronatum* and *R. oomurasaki* (Ezuka 1974b, 1990b). The present study adds *Rhododendron tashiroi* as a new host in Korea.

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**Annulate *Pluteus* species, a study of the genus
Chamaeota in the United States**

ANDREW M. MINNIS¹*, WALTER J. SUNDBERG¹, ANDREW S. METHVEN²,
SEDONIA D. SIPES¹, & DANIEL L. NICKRENT¹

*drew3@siu.edu

¹Department of Plant Biology, Southern Illinois University at Carbondale
Carbondale, IL USA 62901-6509

²Department of Biological Sciences, Eastern Illinois University
Charleston IL 61920-3099

Abstract—*Chamaeota* is a rare agaric genus traditionally classified in the *Pluteaceae*. The present work offers a treatment of the two species described from the United States. Historical records, morphological and anatomical examinations of type and other collections, and molecular data from nuclear LSU rDNA sequences were studied. Typifications of *Annularia mammillata* and *A. sphaerospora* are offered for nomenclatural stability. *Chamaeota sphaerospora* is synonymized with *C. mammillata* and the new combination *Pluteus mammillatus* is proposed.

Key words—*Agaricales*, taxonomy, *Hispidoderma*, lectotype, epitype

Introduction

The genus *Chamaeota* (W.G. Sm.) Earle, typified by *C. xanthogramma* (Ces.) Earle, a poorly known fungus, is typically classified in the *Pluteaceae* Kotl. & Pouzar (Singer 1986) because the better known species have pink basidiospores, free lamellae, a convergent lamellar trama, and an annulus. The genus shares the first three characters with *Pluteus* Fr. and *Volvariella* Speg., the other members of the family, but differs in the last (Singer 1986). Recent molecular evidence, however, suggests that *Pluteus* and *Volvariella* together do not form a clade (Moncalvo et al. 2002). The relationship of *Chamaeota* to other agarics and its potential use as an outgroup for *Pluteus* was unknown.

Chamaeota is a small genus consisting of approximately ten species worldwide. Species of *Chamaeota* have been infrequently reported in the United States from a limited number of sites (Longyear 1902, Peck 1906, Murrill 1917, Murrill 1943, Kauffman 1918, Beardslee 1939). Species delineation remains unclear and several authors (Kauffman 1918, Beardslee 1939, Murrill 1943, Singer 1978) have commented on the need to clarify the range of variation and boundaries of individual species. Two species, *Chamaeota sphaerospora* and *Chamaeota mammillata* are the only species originally described from the United States. Their interpretation is made difficult by the lack of explicitly designated type specimens. The present paper is offered to address these problems in the United States.

Materials and methods

Molecular Study

Genomic DNA was isolated from the ASM 7916 collection identified by classical morphology and anatomy as *C. sphaerospora* using a version of the method described by Nickrent (1994) scaled down to use less material. Universal primers routinely used in Vilgalys' laboratory at Duke University (<http://www.biology.duke.edu/fungi/mycolab/primers.htm>) were employed to amplify (5.8SR, LR7) and to obtain (LR5, LR16, LROR, LR3R) a partial nuclear LSU rDNA sequence using standard protocols. The resulting sequence was subsequently aligned manually to the LSU sequence alignment used in the analysis of Moncalvo et al. (2002). A heuristic parsimony analysis similar to that of Moncalvo et al. (2002) was performed to place the sequence on a fungal tree (results not shown). The above analysis placed the sequence within a *Pluteus* clade. A reduced dataset containing 21 taxa was constructed to demonstrate the position of *Chamaeota* within the *Pluteus* clade. *Limacella illinita* (Fr.) Maire, *Volvariella volvacea* (Bull.) Singer, and *Auricularia polytricha* (Mont.) Sacc. were chosen as outgroup taxa because of their positions outside of the *Pluteus* clade. A branch-and-bound analysis was performed with the following parameters: gaps treated as missing data, multistate taxa interpreted as uncertainty, addition sequence furthest, branches collapsed if maximum branch length is zero, MulTrees option in effect, characters weighted using the Moncalvo et al. (2002) stepmatrix. Branch robustness was evaluated with 1000 bootstrap replications using identical search parameters.

Morphological & anatomical study

Fresh collections identified as *Chamaeota sphaerospora* were made, documented, and preserved with standard methods (Smith 1949). Color terms are from Kornerup and Wanscher (1978). Standard techniques were used to prepare material for anatomical study (Smith 1949, Largent et al. 1977). Dried material was wetted with 95% ethanol for 1 min, soaked in water for 1 min, blotted to remove excess water, and sectioned by hand. Material was mounted and viewed in 3% KOH or Melzer's reagent. Basidiospore dimensions of the newly designated lectotype of *Annularia sphaerospora* are based on observation of 30 basidiospores. All other microscopic dimensions are based on observation of at least 10 structures. Length to width ratios are reported as Q. Mean values for length, width, and Q are designated as L^m , W^m , and Q^m respectively. Anatomical data for the lectotype of *A. sphaerospora* are presented separately in the species description because of the importance of this collection. Data from other specimens are presented as a composite description under "additional data" where they add to or differ from the type material and original circumscription. Herbarium acronyms are from Holmgren and Holmgren (1998 onwards).

Results

The nuclear LSU rDNA dataset analyzed included 781 characters. Of these, 74 were parsimony-informative. The maximum parsimony analysis produced one shortest tree of 990.3 steps (Fig. 1). The consistency (CI), homoplasy (HI), retention (RI), and rescaled consistency (RC) indices were 0.7157, 0.2843, 0.7698, and 0.5509, respectively.

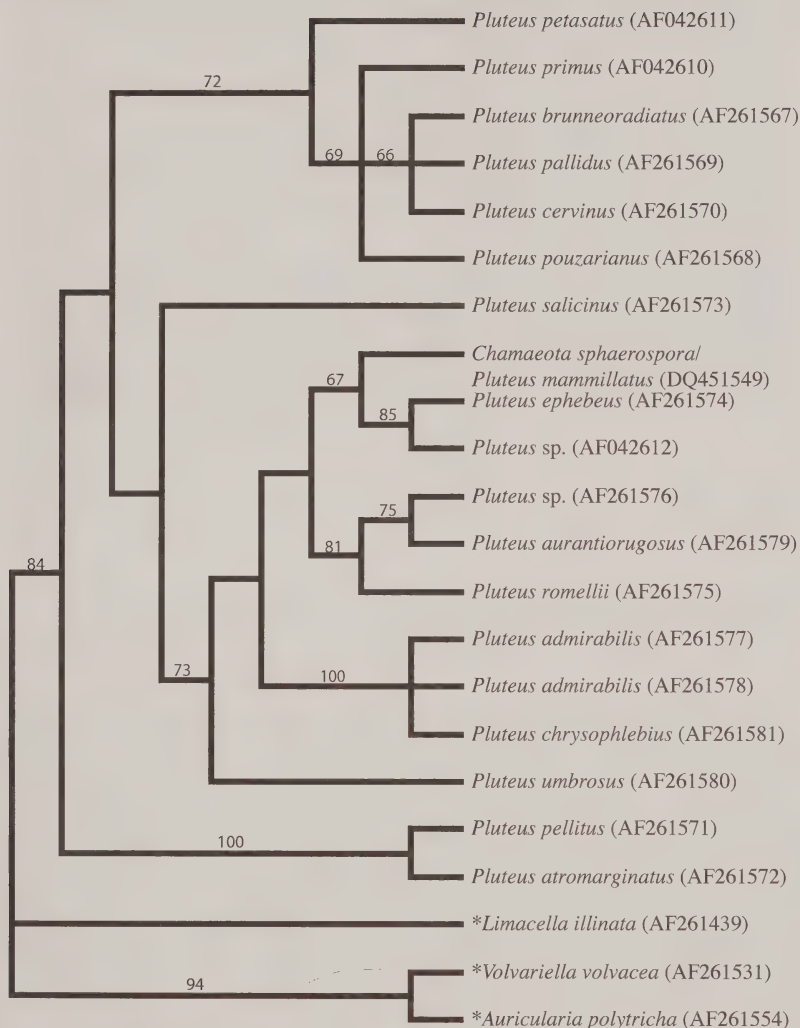


Fig. 1. The single most parsimonious tree based on partial nuclear LSU rDNA sequences. Bootstrap values greater than 50% are indicated above branches. Genbank accession numbers for each sample are shown. All sequences originated in the Moncalvo et al. (2002) study except *Pluteus* sp. (AF042612) from Moncalvo et al. (2000) and *Chamaeota sphaerospora*/*Pluteus mammillatus* from this work. Asterisks denote outgroup taxa.

Pluteus forms a clade (84% BS) with the sequence of the ASM 7916 collection of *C. sphaerospora* embedded within it. There is moderate bootstrap support (67% BS) for a sister relationship of the ASM 7916 sequence to the *P. ephebeus* clade.

Typification

Chamaeota mammillata (Longyear) Murrill, N. Amer. Fl. 10: 139. 1917.

- ≡ *Annularia mammillata* Longyear, Rep. Mich. Acad. Sci. 3: 59. 1902. Type: Pl. I, Fig. 4 in Longyear, Rep. Mich. Acad. Sci. 3: 58. 1902—**Lectotype [icon.] designated here.** Type: *Annularia mammillata* Longyear, *Pluteus mammillatus* Minnis et al., ASM 7916 (EIU)—**Epitype designated here.**

When Longyear (1902) named the species, he based it on a single basidiocarp collected from Greeneville, Michigan on a decaying log in woods and did not explicitly designate a type. The original material mentioned in the protologue was not found at Michigan State University, formerly the Michigan Agricultural College (Heather Hallen and Alan Fryday, pers. comm.). Likewise, it is not present at the New York Botanical Garden (NY) (Barbara Thiers, pers. comm.) or the University of Michigan Herbarium (MICH). It is apparently lost. No other authentic material or other specimens are available for study. Since it is allowable to select an illustration as a lectotype, we chose the figure from Longyear's original circumscription. See Fig. 2 for a reproduction of this image. In order to facilitate a more precise taxonomic interpretation, a collection used in this study was chosen as the epitype. All of the specimen data on the herbarium box are given above.

Chamaeota sphaerospora (Peck) Kauffman, The *Agaricaceae* of Michigan 534. 1918.

- ≡ *Annularia sphaerospora* Peck, Bull. Torrey Bot. Club 33: 216. 1906. Type: *Annularia sphaerospora* Peck, Loc. Detroit, Mich, Leg. O.E. Fischer, Aug. '05 (NYS)—**Lectotype designated here.**

In the protologue, Peck gave O.E. Fischer, a physician, credit for collecting the material used to circumscribe the species. However, unpublished correspondence between Peck and Fischer indicate that a Mr. Burrows of 50 Hazelwood Ave. (Detroit?) was the collector. Fischer sent one of the two collections given to him by Mr. Burrows to Peck. This material mentioned in the protologue was apparently used by Peck to write the circumscription, but he did not clearly designate a type. All of the type specimen data present on the specimen label are given above. An isoelectotype not mentioned in the original species description is located in the University of Michigan Herbarium (MICH). According to the herbarium collection manager, Patricia Rogers (pers. comm.), Dr. Pierre-Arthur Moreau noticed some *Hebeloma* material mixed in with this collection. We have not examined this collection.

Taxonomy

Pluteus mammillatus (Longyear) Minnis, Sundb., & Methven, comb. nov. Figs. 2-7.

- ≡ *Annularia mammillata* Longyear, Rep. Mich. Acad. Sci. 3: 59. 1902 (basionym).
- ≡ *Chamaeota mammillata* (Longyear) Murrill, N. Amer. Fl. 10: 139. 1917.
- = *Annularia sphaerospora* Peck, Bull. Torrey Bot. Club 33: 216. 1906.
- ≡ *Chamaeota sphaerospora* (Peck) Kauffman, The *Agaricaceae* of Michigan 534. 1918.

Data based on study of the lectotype of *Annularia sphaerospora*:

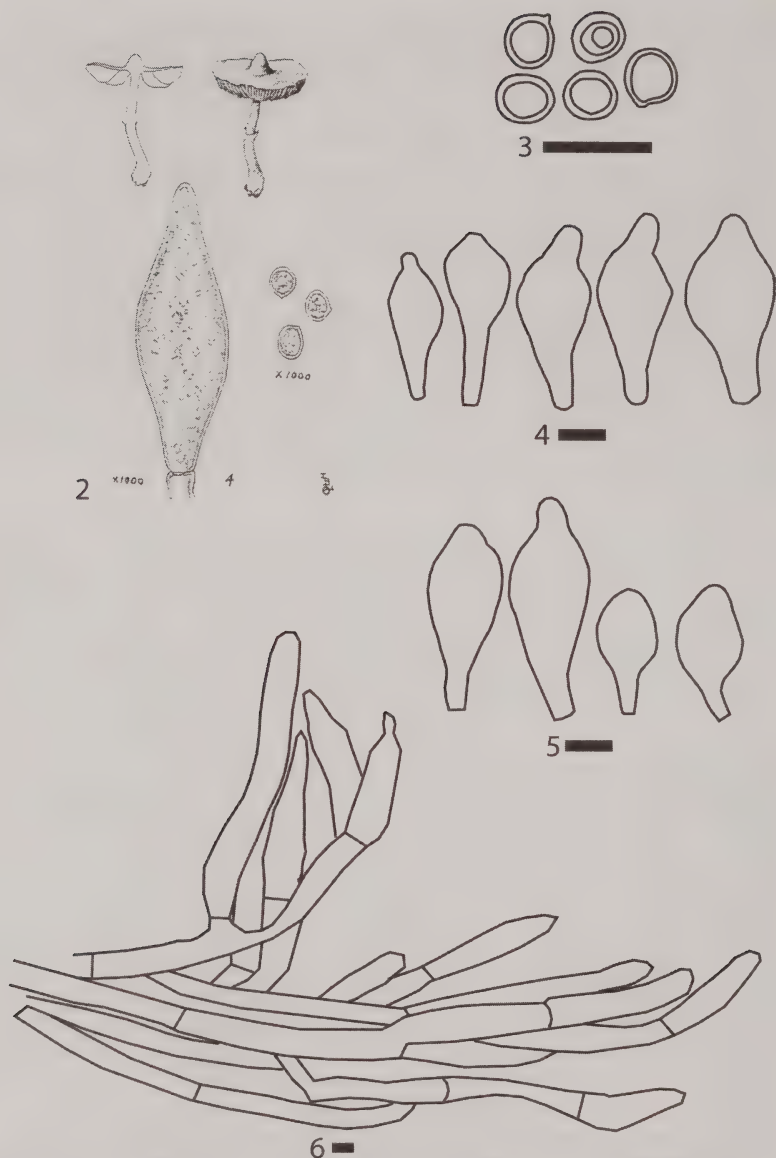
Basidiospores globose to subglobose to short-ellipsoid to slightly ovate in face and profile views, circular in end-view, $5.3\text{--}7.0 \times 4.8\text{--}6.6\ \mu\text{m}$, $Q = 1.0\text{--}1.18$ ($L^m = 6.1\ \mu\text{m}$, $W^m = 5.5\ \mu\text{m}$, $Q^m = 1.11$), apiculate, smooth, walls slightly thickened, subhyaline to pale yellow in KOH, with a single large oil drop inside or several smaller drops resulting in a granular appearance. Basidia clavate, tetrasterigmate, $20\text{--}23 \times 7\text{--}9\ \mu\text{m}$ without sterigmata, walls thin and hyaline in KOH. Pleurocystidia abundant, broadly to narrowly fusoid-ventricose with pedicels and short necks with obtuse apices, $37\text{--}61 \times 14\text{--}24\ \mu\text{m}$, walls thin and hyaline in KOH, no apparent contents. Cheilocystidia abundant, vesiculate to clavate to fusoid-ventricose, $31\text{--}58 \times 11\text{--}22\ \mu\text{m}$, walls thin and hyaline in KOH, no apparent contents. Lamellar trama convergent. Subhymenium cellular. Pileipellis more or less a cutis with bundles of erect to appressed hyphae that are more abundant towards the disc, hyphae thin-walled occasionally containing light brown intracellular pigment. Context composed of $3\text{--}15\ \mu\text{m}$ wide hyphae, thin-walled, hyaline in KOH, no apparent contents. Stipitipellis a cutis of cylindrical hyphae, $3\text{--}8\ \mu\text{m}$ wide, thin-walled, hyaline in KOH, no apparent contents. Clamp connections absent. All anatomical features inamyloid in Melzer's reagent.

Additional data:

Pileus 0.9–7 cm in diameter, initially conic-campanulate becoming convex-plane, low narrow to broad umbo present or not; margin entire, slightly striate, occasionally appendiculate, initially incurved then becoming decurved; surface dry, radially fibrillose with fibrillose scales on disc, fibrils becoming smaller and more separated towards the margin, fibrils light brown to brown (6D7–D6, 6E8–E6); ground color deep yellow to orange yellow (4A–8–A6 to 4B8–B7). Lamellae free, close, thin, broad, not marginate, white becoming grayish red (7B3) in age. Lamellulae in two tiers. Stipe 0.2–8 cm $\times$ 1–14 mm, equal or narrowly clavate, terete, whitish to pale yellow (3A3), surface dry, longitudinally fibrillose or streaked, fibrils concolorous with those on pileus, basal tomentum white. Annulus found on lower 1/2 to 1/3 of stipe, white to yellowish white (4A2, 3A2), thin, membranous, sheathing with flaring apex, occasionally evanescent. Flesh of pileus and stipe solid, white. Odor and taste not distinctive.

Basidiospores brownish pink in mass, $4.8\text{--}7.0 \times 3.1\text{--}6.6\ \mu\text{m}$, $Q = 1.08\text{--}1.88$ ($L^m = 6.1\ \mu\text{m}$, $W^m = 5.3\ \mu\text{m}$, $Q^m = 1.17$). Basidia $17\text{--}29 \times 6\text{--}11\ \mu\text{m}$, usually with granular contents. Pleurocystidia rarely broadly clavate, $39\text{--}99 \times 8\text{--}30\ \mu\text{m}$. Cheilocystidia $30\text{--}86 \times 8\text{--}24\ \mu\text{m}$. Pileipellis hyphae often containing brown intracellular pigment, $5\text{--}13\ \mu\text{m}$ wide. Stipitipellis hyphae $4\text{--}18\ \mu\text{m}$ wide, with or without brown intracellular pigment. Caulocystidia consist of cylindrical hyphae with obtuse apices, $5\text{--}9\ \mu\text{m}$ wide, thin-walled, with brown intracellular pigment. Annulus composed of filamentous hyphae, $3\text{--}10\ \mu\text{m}$ wide, thin-walled, hyaline in KOH, no apparent contents.

Specimens examined—UNITED STATES. FLORIDA: Seminole Co., Oviedo, 22.XII.1935, coll. HC Beardslee Jr. (35135, MICH as *Chamaeota pusilla*); 9.XI.1936, coll. HC Beardslee Jr. (35135, MICH as *Chamaeota fenzlii*); Highlands Hammock State Park near Sebring, 1942, coll. R Singer, F244a (F). MICHIGAN: Wayne Co., Detroit, VIII.1904, coll. RH Stevens (F as *Annularia fenzlii*). MISSOURI: Wayne Co., Mingo National Wildlife Refuge near Puxico, scattered on lignicolous substrates, 20.IX.2003, coll. AM Minnis, Minnis 3-09-20-1 (SIU) & Minnis 3-09-20-2 (SIU); 17.IX.1994, coll. AS Methven, ASM



Figs. 2-6. *Pluteus mammillatus*. Fig. 2. Lectotype illustration of *Annularia mammillata* from Longyear (1906). Fig. 3. Basidiospores (*A. sphaerospora* lectotype). Fig. 4. Pleurocystidia (*A. sphaerospora* lectotype). Fig. 5. Cheilocystidia (*A. sphaerospora* lectotype). Fig. 6. Pileipellis (Minnis 5-09-20-1). Scale bars for Figs. 3-6 = 10 μ m.



Fig. 7. *Pluteus mammillatus*. Basidiocarps of two collections, Minnis 3-09-20-1 and Minnis 3-09-20-2.

7916, DQ451549 (designated epitype of *A. mammillata*, EIU); 20.IX.2005 coll. AM Minnis, Minnis 5-09-20-1 (SIU).

Comments—This species is easily recognized in the field by its yellowish pileus, free, dirty-pink lamellae, annulus, and occurrence on decaying deciduous substrates. Microscopically, there is considerable variation in pleurocystidial shape. This variation around the fusoid-ventricose type is present within and among individual basidiocarps. In our experience, this variation is not unusual in *Pluteus*. Kauffman (1918) did not note the presence of pleurocystidia in *Chamaeota sphaerospora*. However, they are present in all of the collections we have examined. Hesler noted the presence of pleurocystidia on an annotation label for the lectotype of *A. sphaerospora*. Despite the misleading species epithet of *C. sphaerospora*, the spores are not always globose.

Murrill (1917) considered *C. mammillata* to be a synonym of *C. sphaerospora*. Kauffman (1918) and Singer (1978) recognized the two as distinct species. Considering the range of variation we have seen in *C. sphaerospora*, Longyear's description (1902) is a match and the two species are synonyms. See discussion for justification of the transfer to *Pluteus*.

Pluteus mammillatus (designated above) is rarely collected in the United States. Even so, it appears to be widespread in the Eastern United States. It has also been reported from Argentina (Moreno and Albertó 1996). Wright and Albertó (2002) included a photograph with their description of an Argentinean collection that appears to be *P. mammillatus*. We have not examined any of the South American collections.

Chamaeota fenzlii (Schulzer) Singer, a European species, is similar. According to Singer's description, it differs from *C. sphaerospora* by possessing yellow-marginate lamellae (1978).

Discussion

Singer (1986) discussed the similarities of *Chamaeota* to *Pluteus* section *Hispidoderma* Fayod. This section is characterized by a pileipellis consisting entirely of elongated

elements and thin-walled cystidia. The species of *Chamaeota* noted by Singer differ primarily by the presence of a partial veil. For convenience in matters of identification, Singer (1986) felt that it was acceptable to maintain the genus as separate at that time despite the number of other agarics where the presence or absence of a veil does not warrant genus level distinction. In contrast, in his seminal work on *Pluteus* in South America, Singer (1958) noted the presence of a rudimentary volva in *Pluteus stephanobasis* Singer and stated that it was acceptable to maintain this species in the genus instead of placing it in *Volvariella*. Characters that are not found in *Volvariella* including metuloid pleurocystidia and the lack of a natural transition from a rudimentary volva to the more complex volvas found in *Volvariella* supported his view (Singer 1958).

Based on the molecular evidence presented in this study, *Chamaeota* is not a good outgroup for *Pluteus* because it is in the *Pluteus* clade. The partial veil of *C. mammillata* is a derived character within this *Pluteus* lineage. Of the taxa examined, *C. mammillata* is most closely related to *Pluteus ephebeus* (Fr.) Gillet, a member of *Pluteus* section *Hispidoderma*. We feel that the partial veil does not warrant exclusion of *C. mammillata* from the genus *Pluteus*. Future descriptions of the genus should be modified to potentially include the presence of a partial veil.

Interestingly, *Chamaeota tropica* Pegler and *Chamaeota subolivascens* Courtec. are described as having cellular pileipelli (Pegler 1983, Courtecuisse 1991). This feature is also found in *Pluteus* section *Celluloderma* Fayod. It would be interesting to know if these species are also derived from within the *Pluteus* lineage. If so, a partial veil is likely to have been derived more than one time in the genus. Future studies on the other species of *Chamaeota* including the type of the genus, *C. xanthogramma*, should be performed. It is our belief that the genus will be rendered obsolete.

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Tylopilus microsporus, a new species from Southwest China

S.-Z. FU^{1,3}, Q.-B. WANG¹ & Y.-J. YAO^{1,2*}

yaoyj@sun.im.ac.cn

¹Key Laboratory of Systematic Mycology and Lichenology
Institute of Microbiology, Chinese Academy of Sciences
Beijing 100080, China

²Mycology Section, Royal Botanic Gardens, Kew
Richmond, Surrey TW9 3AB, UK

³Graduate School of Chinese Academy of Sciences, China

Abstract—A new species, *Tylopilus microsporus*, collected from Sichuan and Yunnan, China, is described and illustrated. The new species is characterized by pale violet to violet pileus, paler purple to purplish brown stipe, flesh color to pale purplish red hymenophore and small spores. The differences between this species and its related taxa, such as *T. plumbeoviolaceus*, *T. rubrobrunneus*, *T. plumbeoviolaceoides* and *T. violatinctus*, are discussed.

Key words—*Boletaceae*, boletes, taxonomy

Introduction

Tylopilus P. Karst. is a cosmopolitan genus in *Boletales* with about 75 species worldwide (Kirk et al. 2001). Some species in the genus are edible but others are considered mildly poisonous (Singer 1986). Singer et al. (1991) considered tropical Asia and Central America as the distribution centres of *Tylopilus*, but its species are widespread, e.g. North America (Smith & Thiers 1971, Bessette et al. 2000), Asia (Corner 1972, Nagasawa 1997, Li & Song 2000), Mexico and Central America (Singer et al. 1991) and Australasia (Pegler & Young 1981, Li & Watling 1999, Watling 2001). Some uncertainties remain as to the taxonomic position of the genus largely owing to poor generic definitions. The genus was originally limited to *T. felleus* (Bull.) P. Karst., and defined as being gymnocarpic, ectomycorrhizal and producing pinkish, light greyish brown or pinkish orange-brown basidiospores not exceeding 15 µm in length by Pegler & Young (1981), who also placed the genus within *Strobilomycetaceae* E.-J. Gilbert. This taxonomic treatment was accepted by Hawksworth et al. (1995). However, the genus is also characterized by having pinkish, pinkish orange, reddish brown, to purplish brown, amber brown or rusty brown basidiospores, lacking a veil and generally having pallid tubes when

* Author for correspondence.

young (Smith & Thiers 1971, Wolfe, 1979, Bessette et al. 2000), and placed in *Boletaceae* Chevall. (Watling 1970, Smith & Thiers 1971, Singer 1986, Kirk et al. 2001).

There is no major molecular study on the relationships within *Tylopilus* and between *Tylopilus* and *Strobilomyces* Berk. *Tylopilus* s. l. may not be monophyletic, but a clade of *Tylopilus* spp. including *T. felleus* is the sister-group to *Leccinum*, while *Strobilomyces* spp. are at the base of the *Boletaceae* (Binder 1999). The narrow generic concept proposed by Pegler & Young (1981) may be better to maintain the monophyletic position for *Tylopilus*, but it is difficult to define *Tylopilus* and to justify it as a natural genus in *Boletaceae* or in *Strobilomycetaceae* because of the simplicity and plasticity of morphological and anatomical characters and the lack of molecular data.

In China, species of the genus have been reported from various areas but mainly from the South and the South-west (Chiu 1948, Zang 1986, Ying & Zang 1994, Li & Song 2000), especially in Guangdong, Sichuan and Yunnan provinces. The early Chinese records of *Tylopilus* were mostly given as *Boletus* L. A total of some 30 taxa, including species and varieties, has so far been reported (Tai 1979, Zang 1986, Ying & Zang 1994, Yuan & Sun 1995, Shao & Xiang 1997, Chen & Peng 1998, Mao 1998, 2000, Zhang 1999, Li & Song 2000, Li et al. 2002, Wang et al. 2004) and a check-list of the genus in China with a review of all taxa reported is currently underway (Wang et al., in preparation).

In this paper, a new species of *Tylopilus* is proposed and illustrated, based on several collections made from Yunnan and Sichuan during an investigation into the diversity of macrofungi in the South-west of China.

Materials and Methods

All the specimens used in this study were collected from Yunnan and Sichuan, China, and are deposited in the Herbarium Mycologicum, Academia Sinica (HMAS). The macro-characters described here were based on fresh collections. The collections were dried by using an electric air-ventilation drier. Micro-characters were examined in a 5% KOH solution in laboratory from dried specimens. The line drawings of basidiospores and pleurocystidia were made with the assistance of a camera lucida. The sizes of basidiospores are based on at least 30 measurement of each mature specimen.

Taxonomy

Tylopilus microsporus S.Z. Fu, Q.B. Wang & Y.J. Yao sp. nov.

Figs 1 & 2

Etymology: The epithet refers to the comparatively small basidiospores found in this species.

Pileus hemisphericus, convexus vel subconvexus, 6.0–12.0 cm latus, subamethystinus, amethystinus vel brunneo-amethystinus, subtomentosus vel pruinosis. Contextus 1.0–2.0 cm crassus ad centrum, cretaceus, constans; odor indistinctus, sapor amarus. Tubuli ad 5.0–10.0 mm longi, depressi ad stipitem, juvenes albi, maturi constanter albi vel parum subrosei; pori subangulares vel rotundi, 3–4 per mm, cretacei primum, deinde carnei vel pallide purpureo-coccinei, maturitate parum brunnei. Stipes cylindricus, 5.0–14.0 cm longus, 1.0–3.5 cm crassus ad centrum, subaequalis vel saepe leniter amplificatus deorsum, non reticulatus, leniter striatus, cretaceus vel brunneus, apice parum amethystinus, juventute deorsum pallide brunneo-amethystinus, amethystinus vel brunneo-amethystinus, maturitate pallide brunneus vel brunneus, basi albus, solidus. Basidiosporae (6.5–)7.0–

9.0(–10.0) $\times$ 3.0–4.0(–5.0) μm , subfusoid, glabrae, pallide subroseo-brunneae. Basidia 22–24 $\times$ 8.0–9.0 μm , clavata. Cystidia 37–58 $\times$ 8.0–12.0 μm , clavata vel fusoides infra inflata, in solutione KOH intus pallide aurantiaca. Trama hymenophori divergens. Hyphae hyalinae, fibulis destitutis.

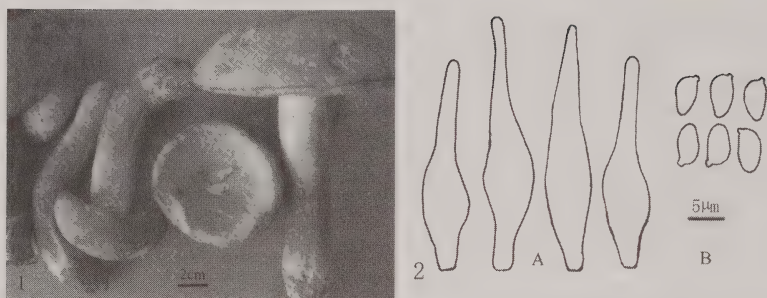
Pileus 6.0–12.0 cm in diam., at first hemispherical, becoming convex, subconvex to nearly applanate at maturity; margin incurved at first, becoming decurved with a narrow band of sterile tissue; surface dry, subtomentose or more or less pruinose, pale violet to violet when young, becoming pale violet, purple pink, with brown tints when mature, then pale brownish with greyish violet tints when old, often pale yellow brown at centre and with pale violet tints at margin; unchanging or slightly deeper on bruising. *Context* 1.0–2.0 cm thick at centre, white, unchanging when bruised, odour not distinctive, taste very bitter. *Tubes* 5.0–10.0 mm long, white when young, and remaining so when mature or slightly pinkish, unchanging when bruised, adnate to slightly depressed around the stipe; pores nearly round, 3–4 pores per mm, white at first, becoming flesh-coloured to purplish pink to pale violet with slightly brown tints when mature, unchanging when bruised. *Stipe* 5.0–14.0 cm long, 1.0–3.5 cm thick, sub-cylindric, always enlarging downward, non-reticulate, slightly striate or subglabrous, white or brownish with pale purple to violet tints at the apex, pale brownish lilac to lilac or brownish lilac downwards when young, becoming brownish to brown, with white mycelium at the base, solid; context white, unchanging when bruised. *Basidiospores* (6.5–)7.0–9.0(–10.0) $\times$ 3.0–4.0(–5.0) μm , subfusoid, distally expanding, smooth, thin-walled, pale pinkish brown containing one or two oil-droplets. *Basidia* 22–24 $\times$ 8.0–9.0 μm , clavate, 2- or 4-spored. *Pleurocystidia* 37–58 $\times$ 8.0–12.0 μm , copious, clavate to fusoid, inflated below, with pale golden yellow contents in KOH. *Hymenophoral trama* of *Boletus*-type, typically divergent from a central strand, hyphae hyaline in KOH, thin-walled. *Pileipellis* an interwoven trichodermium, slightly brown in KOH. *Stipitipellis* a trichodermium, with some short, narrowly ventricose dermatocystidia 35–60 $\times$ 6.5–12.0 μm . *Clamp-connections* absent.

Specimens examined: China: Yunnan, Kunming, Heping Village Market, 31 Aug. 2002, Q. B. Wang No. 85, HMAS 79720; Simao, Simao Market, 10 Aug. 2003, Q. B. Wang No. 190, HMAS 84730 (HOLOTYPE). Sichuan, Dechang County, Badong Town, Gaofeng, 1900 m alt., solitary to gregarious on the ground, in mixed woods, 16 Aug. 2003, Q. B. Wang & S. Z. Fu No. 234, HMAS 84743; Dechang County, Badong Town, Yinjiashan, 2200 m alt., solitary on the ground, in mixed woods, 14 Aug. 2003, S. Z. Fu No. 12, HMAS 79471; Dechang County, Nanshan Town, Datianwan Village, 1700 m alt., solitary on the ground, under the mixed woods of *Quercus* sp. and *Pinus* sp., 15 Aug. 2003, S. Z. Fu No. 32, HMAS 79468; same locality and same date, solitary to gregarious on the ground, S. Z. Fu No. 33, HMAS 84745; same locality and same date, gregarious, S. Z. Fu No. 34, HMAS 79458.

Habit and habitat: Solitary to gregarious on the ground in mixed woods with *Quercus* sp. and *Pinus* sp.

Distribution: China: Yunnan and Sichuan.

This species is mainly characterized by the pale violet to violet pileus, pale purple hymenophore, brownish stipe and small spores, (6.5–)7.0–9.0(–10.0) $\times$ 3.0–4.0(–5.0) μm . These characters, together with the very bitter context, may be confused with other closely related species in the field, such as *T. plumbeoviolaceoides* T.H. Li et al., *T.*



Figs 1 & 2. *Tylopilus microsporus* (HMAS 84730, Holotype). Fig. 1. Photograph of basidiomata. Fig. 2. Line drawing of microscopic characters. A. Pleurocystidia; B. Basidiospores.

plumbeoviolaceus (Snell & E.A. Dick) Singer, *T. rubrobrunneus* Mazzer & A.H. Sm. and *T. violatinctus* T.J. Baroni & Both, which have a vinaceous or purple brown pileus and very bitter context.

Tylopilus microsporus differs from *T. rubrobrunneus* and *T. plumbeoviolaceus* in having smaller spores. The spores of *T. rubrobrunneus* are $10\text{--}14 \times 3.5\text{--}4.5\ \mu\text{m}$ (Smith & Thiers 1971, Bessette et al. 2000) or $12\text{--}14 \times 4\text{--}5\ \mu\text{m}$ (Grund & Harrison 1976), larger than those of *T. microsporus*. Furthermore, the pileus of *T. rubrobrunneus* is purple-brown, dark reddish brown, dull brown or cinnamon in age (Bessette et al. 2000), while the pileus of *T. microsporus* is pale violet, purple pink, with brown tints. Although spores of *T. plumbeoviolaceus* were measured as $7\text{--}9 \times 2.8\text{--}4\ \mu\text{m}$ (mostly $8\text{--}9 \times 3\ \mu\text{m}$) by Snell & Dick (1941), Singer (1947) considered the spore size of $9.5\text{--}14 \times 3\text{--}3.8\ \mu\text{m}$ (most frequently $10.2\text{--}12 \times 3.3\text{--}3.5\ \mu\text{m}$) was reasonably constant because of slow maturing of the spores in this species. Singer et al. (1991) gave the same size of spores for collections from Mexico. The spore size of $10\text{--}13 \times 3\text{--}4\ \mu\text{m}$ was also provided for *T. plumbeoviolaceus* by both Smith & Thiers (1971) and Bessette et al. (2000), and $11\text{--}14 \times 4\text{--}5\ \mu\text{m}$ by Grund & Harrison (1976). All these spore measurements are larger than those in *T. microsporus*. Further, the pileus of *T. plumbeoviolaceus* is quite violaceous when young (Snell & Dick, 1941), contrasting pale violet to violet when young in *T. microsporus*.

Tylopilus plumbeoviolaceoides was described from Guandong, China, by Li et al. (2002). It has a dark violaceous, brown-vinaceous to purple-chestnut pileus, which is subviscid to viscid, and the pileipellis is an ixotrichodermium or a trichodermium with some gelatinized material; whilst the pileus of *T. microsporus* is dry, pale violet to violet when young and becoming pale violet, purple pink, with brown tints in age, and the pileipellis is an interwoven trichodermium without gelatinized material. The stipe of *T. plumbeoviolaceoides* is concolorous with the pileus to more pinkish chestnut, compared with the brownish stipe of *T. microsporus*. Further, the spores of *T. plumbeoviolaceoides*, $(7.5\text{--})8.5\text{--}10.5\text{--}(12) \times (2.5\text{--})3\text{--}3.8\text{--}(4.2)\ \mu\text{m}$ (Li et al. 2002), are longer than those of *T. microsporus*. The fungus illustrated for *T. plumbeoviolaceoides* by Wang et al. (2004) from Yunnan is the same as *T. microsporus* described here (Wang, pers. comm.).

Tylopilus violatinctus, hitherto known only from North America, is another similar species, but its pileus becomes rusty violet to dark violet and stipe turns typically to dull yellow to yellow brown when bruised, and its hymenophore becomes pinkish flesh-color

and finally deep cocoa-brown when mature (Bessette et al. 2000); contrasting to the unchanging, or just deeper, pileus and the unchanging stipe when bruised, and the pale violet, purple pink, with brown tints hymenophore when mature in *T. microsporus*.

The complex of *Tylopilus* species with purplish-tinted basidiomata is difficult to determine by macro-characters alone. There might be many species involved in this complex. Further studies, especially DNA sequence analyses, are needed in order to understand the complex.

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An annotated checklist of *Leccinum* in China

S.-Z. FU^{1,2}, Q.-B. WANG¹ & Y.-J. YAO^{1*}

yaoyj@sun.im.ac.cn

¹Key Laboratory of Systematic Mycology and Lichenology
Institute of Microbiology, Chinese Academy of Sciences
Beijing 100080, China

²Graduate School of Chinese Academy of Sciences
Beijing 100049, China

Abstract—Species of the genus *Leccinum* reported from China are reviewed and annotated with a summary of their current research status. A total of 32 names have been included from an extensive literature research. Among these names, two are regarded as synonyms of other species of the genus and another one transferred to *Tylopilus*. The taxonomic status of three names, the generic placement of two names and the application of one name to Chinese material are controversial. Among the remaining 23 names, seven were reported without specimen support and 16 with specimen citation. It is also found that the descriptions of six of these taxa from China differ from those from Europe and elsewhere. Specimen citation, morphology description and species identification of the Chinese records are also discussed. The full checklist is posted at <http://www.mycotaxon.com/resources/weblists.html>.

Key words—boletes, distribution, nomenclature

Leccinum Gray is a bolete genus with about 75 accepted species (Kirk et al. 2001) among some 282 proposed names (<http://www.indexfungorum.org/Names/Names.asp>, March 2006). The genus is worldwide, but distributed mainly in the northern temperate zone (Kirk et al. 2001). Species of *Leccinum* are ectomycorrhizal (Singer 1975) and play important roles in both ecology and economy. Ectomycorrhizal basidiomycetes, including the boletes, constitute an important component of forest fungal communities (Dahlberg et al. 1997, Baxter & Dighton 2001, Yan & Yao 2003) and forest ecosystems. It has been shown that ectomycorrhizal fungal diversity can determine plant productivity (Jonsson et al. 2001) and that ectomycorrhizal fungi benefit their hosts by enhancing mineral uptake, thus contributing to the recycling of nutrients in the ecosystem (Dames et al. 1999). Furthermore, all the known species of *Leccinum* seem to be edible; some are used for food and sold in markets as fresh, dried, salted or pickled products (Singer 1975). *Leccinum extremiorientale*, for example, is often found in the wild mushroom market in Kunming, Yunnan, China.

Species of *Leccinum* in China have been the subject of modern scientific studies since the early 20th century but such studies were infrequent until the 1980s. Baccarini

*Author for correspondence

(1905) reported *L. scabrum* from Qinling Mountains, Shanxi, and the same species was subsequently reported some 30 years later as *Boletus scaber* from Jiangsu (Teng 1936). Subsequently, two more *Leccinum* species were reported from Yunnan (Keissler & Lohwag 1937). Chiu (1948) recorded three *Leccinum* species in *Boletus* L. in his comprehensive study of boletes in the south-west of China, mainly Yunnan province. A further species was added by Teng (1963). In a summary of all known Chinese fungi, Tai (1979) included six species of *Leccinum*. Zang carried out further research on boletes in the south-west of China from the 1980s and reported six *Leccinum* species, including one new to science (Zang 1986). Subsequently, 15 species were reported from the same region by Ying & Zang (1994). Some additional species of *Leccinum* were also included in local lists of fungi. In total, 32 names of *Leccinum* have been reported from China. They are listed in Table 1, with references and notes on their current status.

Among the 32 names in Table 1, two are regarded as synonyms of other species of the genus (*L. nigrescens* and *L. rufum*) and one (*L. eximium*) is transferred to *Tylopilus*. The taxonomic status of three (*L. crocipodium*, *L. holopus* and *L. versipelle*), the generic placement of two (*L. chromapes* and *L. subglabripes*), and the name application to Chinese material of one (*L. rugosiceps*) are controversial because of the simplicity and plasticity of morphological and anatomical characters.

Among the remaining 23 names, seven were reported without specimen support, i.e. *L. duriusculum*, *L. intusrubens*, *L. oxydabile*, *L. quercinum*, *L. subleucophaeum*, *L. subradicatum* and *L. variicolor*, and 16 with specimen citation, i.e. *L. albellum*, *L. ambiguum*, *L. atrostitipitatum*, *L. aurantiacum*, *L. extremiorientale*, *L. griseum*, *L. hortonii*, *L. insigne*, *L. olivaceopallidum*, *L. potteri*, *L. roseofractum*, *L. rubropunctum*, *L. rubrum*, *L. scabrum*, *L. subgranulosum* and *L. subleucophaeum* var. *minimum*. The descriptions of some of these taxa from China are different from those of the same taxa from Europe and elsewhere, i.e. *L. olivaceopallidum*, *L. oxydabile*, *L. quercinum*, *L. rugosiceps*, *L. roseofractum* and *L. rubropunctum*. A revision of these taxa is required to verify their occurrence in China.

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Table 1. Species of *Leccinum* in China

Name	Place of publication	Report from China	Note
<i>L. albellum</i> (Peck) Singer	Mycologia 37: 799 (1945)	Yeh & Chen(1982)	√
<i>L. ambiguum</i> A.H. Sm. & Thiers	Boletes of Michigan: 138 (1971)	Dai & Li (1994)	√
<i>L. atrostitatum</i> A.H. Sm.et al.	Michigan Bot. 5: 155 (1966)	Dai & Li (1994)	√
<i>L. aurantiacum</i> (Bull.) Gray	Nat. Arr. Brit. Pl. 1: 646 (1821)	Keissler & Lohwag (1937)	√
<i>L. chromapes</i> (Frost) Singer	Amer. Midl. Nat. 37: 124 (1947)	Keissler & Lohwag (1937)	†
<i>L. crocipodium</i> (Letell.) Watling	Trans. & Proc. Bot. Soc. Edinburgh 39: 200. (1961)	Chiu (1948)	†
<i>L. duriusculum</i> (Schulzer ex Fr.) Singer	Amer. Midl. Nat. 37: 122 (1947)	Mao et al. (1993)	*
<i>L. eximium</i> (Peck) Singer	Persoonia 7: 319 (1973)	Chiu (1948)	= <i>Tylopilus eximius</i> (Peck) Singer
<i>L. extremiorientale</i> (Lar.N. Vassiljeva) Singer	Agar. Mod. Tax. 2nd Ed.: 744 (1962)	AS (1989)	√
<i>L. griseum</i> (QuéL.) Singer	Die Röhrlinge II: 89 (1967)	Yeh & Chen (1981)	√
<i>L. holopus</i> (Rostk.) Watling	Trans. Br. Mycol. Soc. 43: 692 (1960)	Yeh & Chen (1980)	†
<i>L. hortonii</i> (A.H. Sm. & Thiers) Hongo & Nagas.	Rep. Tottori mycol. Inst. 16: 50 (1978).	Ying & Zang (1994)	√
<i>L. insigne</i> A.H. Sm.et al.	Michigan Bot. 5: 160 (1966)	Yeh & Chen (1981)	√
<i>L. intusrubens</i> (Corner) Høil.	Nordic JI Bot. 2: 270 (1982)	Wu et al. (1997)	*
<i>L. nigrescens</i> (Richon & Roze) Singer	Amer. Midl. Nat. 37: 116 (1947)	Chiu (1957)	= <i>L. crocipodium</i>
<i>L. olivaceopallidum</i> A.H.Sm. et al.	Michigan Bot. 6: 125 (1967)	Bi et al. (1997)	#
<i>L. oxydabile</i> (Singer) Singer	Amer. Midl. Nat. 37: 116 (1947)	Mao (2000)	#, *
<i>L. potteri</i> A.H. Sm. et al.	Michigan Bot. 5: 138 (1966)	Dai & Li (1994)	√
<i>L. quercinum</i> E.E. Green & Watling	Notes R. bot. Gdn. Edinb. 29: 151 (1968)	Mao (2000)	#, *
<i>L. roseofractum</i> Watling	Notes. R. bot. Gdn. Edinb. 28: 313 (1968)	Bi et al. (1997)	#
<i>L. rubropunctum</i> (Peck) Singer	Amer. Midl. Nat. 37: 117 (1947)	Chiu (1948)	#
<i>L. rubrum</i> M. Zang	Acta bot. Yunnanica 8: 11 (1986)	Zang (1986)	√
<i>L. rufum</i> (Schaeff.) Kreisel	<i>Boletus</i> Schr Reihe 1: 30 (1984)	Mao (2000)	= <i>L. aurantiacum</i>
<i>L. rugosiceps</i> (Peck) Singer	Mycologia 37: 799 (1945)	Yeh & Chen (1980)	†
<i>L. scabrum</i> (Bull.) Gray	Nat. Arr. Brit. Pl. (London) 1: 646 (1821)	Baccarini (1905)	√
<i>L. subglabripes</i> (Peck) Singer	Mycologia 37: 799 (1945)	Tai (1936–1937)	†
<i>L. subgranulosum</i> A.H. Sm. & Thiers	Boletes of Michigan: 210 (1971)	Ying & Zang (1994)	√
<i>L. subleucophaeum</i> E.A. Dick & Snell	Mycologia 52: 453 (1960)	Li & Song (2000)	*
<i>L. subleucophaeum</i> var. <i>minimum</i> C.S. Bi	Acta Mycol. Sin. 3: 201 (1984)	Bi et al. (1984)	√
<i>L. subradicatum</i> Hongo	Mem. Shiga Univ. 23: 41 (1973)	Mao (2000)	*
<i>L. varicolor</i> Watling	Notes R. Bot. Gdn. Edinb. 24: 268. (1969)	Mao et al. (1993)	*
<i>L. versipelle</i> (Fr.) Snell	Lloydia 7: 58 (1944)	Liu (1991)	†

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New species and new records of *Graphis* from India: transseptate species with completely carbonized exciples and norstictic acid

BHARATI ADAWADKAR & URMILA MAKHIJA

UV_Makhija@hotmail.com

Agharkar Research Institute

G.G. Agarkar Road, Pune - 411004, India

Abstract—The present paper gives an account of ten species of the genus *Graphis*. *G. albidofarinacea*, *G. cinnamomea*, *G. colliculoides*, *G. kollaimalaiensis*, *G. nigrocarpa*, *G. nilgiriensis*, and *G. verruciformis* are described as new to science. *Graphis flavens*, *G. induta*, and *G. marginata* are recorded for the first time from India. The two species *G. flavens* and *G. nilgiriensis* without norstictic acid are described in an appendix.

Keywords—lichenized fungi, ascomycetes, taxonomy, *Graphidaceae*

Introduction

The *Graphidaceae* is a large and widely distributed group of mainly tropical lichens with about 918 species worldwide (Kirk et al. 2001). The clear concepts of the genera (and several species) are available in the recent treatment of *Graphidaceae* (Staiger 2002).

Awasthi (1965), in his “Catalogue of lichens from India, Nepal, Pakistan and Ceylon,” enumerated 36 species of *Graphis* Adans., which were recorded in the nineteenth and the early twentieth centuries by various lichenologists—viz. Bélanger (1838), Leighton (1869), Stirton (1879), Nylander (1867, 1891, 1900), Jatta (1905) and Räsänen (1952)—based on the collections of European botanists or naturalists from India.

Lichenological studies in India were resumed beginning in the early 1940s by Dr. D.D. Awasthi, Dr. P.G. Patwardhan, and their associates. Subsequently 33 new species were recorded and published in various scattered publications by Indian lichenologists [Awasthi & Singh (1975) Awasthi & Singh (1977), Patwardhan & Kulkarni (1976, 1979), Kulkarni (1977), Nagarkar & Patwardhan (1982), Singh & Sinha (1994) and Makhija et al. (1992)].

Awasthi (2000) lists 74 species of *Graphis* so far known from India in his “Lichenology in Indian subcontinent”. We are currently undertaking a detailed survey of this family, which is particularly well represented in India.

As a result of a major revision of the spore genus *Graphis* and studies of recent collections of this genus from India we have discovered approximately 145 species that can be transferred to different genera following the new system set forth by Staiger (2002). Consequently, the transseptate species in the genera —namely, *Acanthothecis*,

Dyplolabia, *Fissurina*, *Graphis*, *Hemithecium*, *Platythecium* and *Thalloloma* — are described elsewhere (Makhija & Adawadkar 2003, 2005a,b; Makhija et al. 2005; Adawadkar & Makhija 2004, 2005).

In the present account we describe ten species in the genus *Graphis* with completely carbonized exciple and colourless, transseptate ascospores from India. *Graphis flavens*, *G. induta*, *G. marginata* are recorded for the first time from India, and *G. albidofarinacea*, *G. cinnamomea*, *G. colliculoides*, *G. kollaimalaiensis*, *G. nigrocarpa*, *G. nilgiriensis*, and *G. verruciformis* are new to science. The two species *G. flavens* and *G. nilgiriensis* without norstictic acid are described in an appendix but are not included in the key.

Materials and Methods

In the present work chemical data has been obtained by thin-layer chromatography using methods standardized for lichen products (Culberson & Kristinsson 1970, Culberson 1972, White & James 1985). All specimens were examined under UV light (365 nm).

We have also consulted morphological and chemical data obtained from the re-examination of type or authentic material of several taxa in the *Graphidaceae* together with photographs of type specimens from the late Dr. Mason Hale, who provided materials for our studies during his several visits to our laboratory at ARI.

Key to the Indian *Graphis* species with norstictic acid, completely carbonized exciples and transseptate ascospores

- 1a. Ascomata concolorous with the thallus 2
- 1b. Ascomata dark or black 4
- 2a. Ascomata short, up to 5 mm long.
Thallus pale grayish brown to brownish gray, thick, warty; ascomata 1–5 mm long, concolorous, simple to branched, immersed; disc narrow; ascospores hyaline, 8–11-transseptate, 33–63 x 4–8 µm; norstictic acid present *G. induta*
- 2b. Ascomata long, more than 5 mm long 3
- 3a. Thallus pale grayish white, rough, warty; ascomata 4–8 mm long, simple to branched, immersed to semi-immersed, terminally acute to subacute; disc white pruinose; ascospores hyaline, 12–14-transseptate, 55–71 x 6–8 µm; norstictic acid present *G. albidofarinacea*
- 3b. Ascomata concolorous with the thallus.
Thallus greenish gray, glossy, uneven; ascomata 1–8 mm long, concolorous, simple to rarely branched; disc white pruinose; ascospores hyaline, 18–21-transseptate, 96–105 x 10–12 µm; norstictic and con-norstictic acids present ... *G. marginata*
- 4a. Salazinic acid present.
Thallus greenishyellow to yellowish brown, finely cracked; ascomata 0.3–8 mm long, black, simple to rarely branched, immersed, terminally acute to subacute; disc cinnamon coloured in wet condition; ascospores 7–15-transseptate, 21–42 x 5–8 µm; norstictic and salazinic acids present *G. cinnamomea*
- 4b. Salazinic acid absent 5

- 5a. Ascospores upto 50 μm long 6
- 5b. Ascospores more than 50 μm long 7
- 6a. Thallus dull greenish gray, warty; ascomata 1–4 mm long, black; ascospores 6–12-transseptate, 37–50 x 4–6 μm ; norstictic acid present *G. verruciformis*
- 6b. Thallus grayish, evanescent; ascomata 0.5–2 mm long, black, simple to branched, semi-emergent, ends round; ascospores 5–9-transseptate, 21–27 x 4–6 μm ; norstictic acid present *G. colliculoides*
- 7a. Thallus green, flaking; ascomata 1–5 mm long, black, simple, triradiately to sparsely and irregularly branched; ascospores 9–13-transseptate, 50–71 x 8–12 μm ; norstictic acid present *G. kollaimalaiensis*
- 7b. Thallus greenish to yellowish buff; ascomata 1–10 mm long, black; exciple present below; ascospores 8–14-transseptate, 33–63 x 4–6 μm ; norstictic acid present *G. nigrocarpa*

Taxonomic descriptions

Graphis albidofarinacea Adaw. & Makhija sp. nov.

Figure 1

Similis Graphis immersa Fink sed thallo farinaceo, ascomata albo pruinoso et ascoporis majoribus differt.

Etymology: from the Latin *albidus*, whitish and *farinosus*, mealy; a reference to whitish, effuse thallus.

Holotype–India, Tamil Nadu, Kodaikanal, 24.9.1973, P.G. Patwardhan & M.B. Nagarkar, 73.2254; *holotype*: AMH.

Thallus whitish grayish-green, rough, unevenly thickened, warty, somewhat effuse to granular. **Ascomata** lirelline, 4–8 mm long, 0.2–0.3 mm broad, simple to branched, irregularly spread, immersed to slightly emergent, terminally acute to obtuse. **Disc** black when exposed, white pruinose. **Exciple** present at the base, convergent, covered by a thalline margin up to the top, not striate, laterally to completely carbonized. **Epithecium** hyaline, thin. **Hymenium** hyaline, not interspersed, 138–232 μm high and 168–315 μm broad, I-, KI-. **Hypothecium** orange yellow, thick, 42–63 μm high. **Paraphyses** simple, long, thin. **Asci** 6–8 sporate. **Ascospores** hyaline, 12–14-transseptate, ellipsoidal, 55–71 x 6–8 μm , I + blue.

Chemistry– Norstictic acid present.

Specimens examined–Tamil Nadu: Kodaikanal, Munnar road, P.G. Patwardhan & M.B. Nagarkar, 73.2248, 73.2253; Kodaikanal, C.R. Kulkarni & P.D. Badhe, 73.2247, 73.2249; P.G. Patwardhan & C.R. Kulkarni, 73.2251 (AMH).

Remarks–The new species *Graphis albidofarinacea* is comparable to *G. immersa* in the nature of the exciple, but differs from the latter species in having white mealy thallus, ascomata covered with white pruina and large ascospores. Ascospores are 38–45 μm long in *G. immersa*.

Graphis albidofarinacea closely resembles an Australian species *G. stenospora* var. *deficiens* A.W. Archer and *G. catherinae* A.W. Archer but they have no lichen substances in their thalli.

Graphis cinnamomea* Adaw. & Makhija sp. nov.*Figure 2***Similis Graphis adpressa* Vain. *sed acida norsticticum et salazincium continens differt.**Etymology:* from the Latin *cinnamomeus*, mixed with yellowish and red; a reference to disc colour.**Holotype**–India, Tamil Nadu, Kodaikanal, near Golf Club, 24.1.1975, P.G. Patwardhan & A. V. Prabhu, 75.184; holotype:AMH.

Thallus greenish yellow to yellowish brown, thick, delimited by thin, black hypothallus. **Ascomata** lirelline, black, 0.3–8 mm long and 0.1–0.2 mm broad, simple to branched, immersed, terminally obtuse. **Disc** narrow, black, cinnamon coloured when wet, pruinose. **Exciple** present at the base, convergent, covered by a thalline margin up to the top, not striate, laterally to completely carbonized. **Epithecium** hyaline to light brown, thin, K-. **Hymenium** hyaline, not inspersed, 52–87 μm high and 105–157 μm broad, I-, KI-. **Hypothecium** hyaline to light orange, 17–21 μm thick. **Asci** 8 sporate. **Ascospores** hyaline, 7–15-transseptate, ellipsoidal, 21–42 $\times$ 5–8 μm , I+ blue.

Chemistry–Norstictic and salazinic acids present.**Specimens examined**–Tamil Nadu: Sim's Park, Coonoor, P.D. Badhe & C.R. Kulkarni, 73.814; Niligiri hills, Korakundha, P.G. Patwardhan 73.1473 (AMH).

Remarks–*Graphis cinnamomea* is characterized by mostly simple ascomata with cinnamon coloured disc covered by white pruina, the not striate, laterally to completely carbonized exciple and the presence of norstictic and salazinic acids. The new species is distinguished from the externally similar *G. adpressa* by the absence of lichen substances and larger ascospores of 46–58 $\times$ 12–5 μm in that species. The combination of norstictic and salazinic acids is rather rare in *Graphis*.

The most closely related *Graphis emersa* Müll. Arg., a species from Queensland, differs from the new species in having only norstictic acid, while the new species has salazinic acid in addition to the norstictic acid in its thallus.

Graphis colliculoides* Adaw. & Makhija sp. nov.*Figure 3***Similis Platythecium colliculosum* (Mont.) Staiger *sed excipulo omnino carbonaceo et acidum norsticticum continens differt.**Etymology:* from the species name *colliculosum*.**Holotype**–India, Tamil Nadu, Devicolam, 25.1.1976, P.G. Patwardhan, 76.701; holotype: AMH.

Thallus grayish green, thin, mostly evanescent, sparsely cracked with age, delimited by thin, black hypothallus. **Ascomata** lirelline, 0.5–2 mm long, 0.1–0.2 mm broad, black, simple to branched, semiemergent, terminally round. **Disc** black, narrow to moderately broad, epruinose. **Exciple** convergent, covered by a crystal studded thalline margin up to the top, not striate, completely carbonized. **Epithecium** hyaline to light brown, K-. **Hymenium** hyaline, not inspersed, 96–105 μm high and 147–155 μm broad, I-, KI-. **Hypothecium** hyaline to pale, thin. **Asci** 8 sporate. **Ascospores** hyaline, 5–9-transseptate, ellipsoidal, 21–27 $\times$ 4–6 μm , I+ blue.

Chemistry–Norstictic acid present.**Remarks**–The present new species resembles *Platythecium colliculosum* in its appearance.

However, *Platythecium colliculosum* has non carbonized exciple and has salazinic and protocetraric acids in its thallus.

It is somewhat similar to *Graphis centrifuga* Räsänen and *G. semiaperta* Müll. Arg. with respect to the characters of ascospores and the chemistry but *G. centrifuga* has the hymenium inspersed and has large lirellae arranged in well defined stellate clusters, where as *G. semiaperta* has mostly simple lirellae and a black epithecium.

***Graphis induta* Müll. Arg., Hedwigia 30: 185, 1891.**

Figure 9

Thallus buff with pinkish tinge, pale grayish brown to brownish gray, thick, distinctly warty, cracked. **Ascomata** lirelline, 1–5 mm long, 0.1 mm broad, concolorous with the thallus, simple to branched, immersed, crowded, terminally acute to obtuse. **Disc** blackish, covered by white pruina. **Exciple** present at the base, convergent, covered by a thalline margin up to the top, not striate, completely carbonized. **Epithecium** hyaline, thin, K-. **Hymenium** hyaline, not inspersed, 120–150 µm high and 170–200 µm broad, I-, KI-. **Hypothecium** hyaline, thin. **Asci** 4–6 sporate. **Ascospores** hyaline, (4-) 8–11-transseptate, ellipsoidal, 33–63 x 4–8 µm, I + blue.

Chemistry– Norstictic acid present.

Specimens examined– Tamil Nadu: Kollaimalai, M.B. Nagarkar & P.G. Patwardhan 85.1625, 85.1626 (AMH).

Remarks–*Graphis induta* can easily be distinguished by its distinctly warty, buff coloured thallus with pinkish tinge; concolorous, crowded ascomata; disc black, white pruinose; not striate, completely carbonized exciple; (4-) 8–11 -transseptate ascospores of 33–63 x 4–8 µm.

The species resembles *Graphis anguilliformis* Taylor but that is distinguished from the present species by the tall, heavily carbonized, robust exciple, larger (75–110 µm long) ascospores and absence of lichen substances in *G. anguilliformis*.

***Graphis kollaimalaiensis* Adaw. & Makhija sp. nov.**

Figure 6

Similis Graphis turgidula var. *norstictica* A.W. Archer sed *lirellis longioribus et ascosporis locularibus minores differt.*

Etymology: from the Latin *ensis*, a place of origin, and Kollaimalai, the type locality.

Holotype–India, Tamil Nadu, Kollaimalai, 15.10.1985, M.B. Nagarkar & P.G. Patwardhan, 85.1526; holotype:AMH.

Thallus green, flaking, cracked, thick. **Ascomata** lirelline, 1–5 mm long, 0.1 mm broad, black, simple to sparsely branched, straight to curved, flat to slightly raised above, scattered, terminally obtuse. **Disc** narrow to slightly broad, dark blackish brown. **Exciple** present at the base, convergent, covered by a thalline margin up to the top, not striate, completely carbonized. **Epithecium** hyaline, thin. **Hymenium** hyaline, not inspersed, 150–160 µm high and 200–210 µm broad, I-, KI-. **Hypothecium** hyaline, thin. **Asci** 8 sporate. **Ascospores** hyaline, 9–13-transseptate, ellipsoidal, 50–71 x 8–12 µm, I + blue.

Chemistry– Norstictic acid present.

Specimens examined–Tamil Nadu: Kollaimalai, P.G. Patwardhan & M.B. Nagarkar 85.1525, 85.1636, 85.1637 (AMH).

Remarks–The present new species seems to be similar to *Graphis tenuescens* Nyl. from which it differs in having 8 sporate asci. In *G. tenuescens* the asci are 1–2 sporate.

It can easily be distinguished from the somewhat similar species *Graphis leucoparypha* Kremp. by its thick, flaking thallus, much conspicuous lirellae and with only 9–13-transseptate ascospores. *Graphis leucoparypha* has (15–) 16–18 (–20) locular ascospores and has only 0.5–2(–3) mm long lirellae.

Graphis marginata Raddi, Memor. Soc. Ital. Sc. 18: 344, 1820.

Figure 5

Thallus greenish gray, thick, uneven, cracked, glossy. **Ascomata** lirelline, 1–8 mm long, 0.1–0.2 mm broad, concolorous, simple to rarely branched, immersed to slightly raised, scattered, terminally round. **Disc** very narrow, black, covered by white pruina. **Exciple** present at the base, convergent, covered by a thalline margin up to the top, not striate, slightly irregular outline, thick, completely carbonized. **Epithecium** brownish, thin. **Hymenium** light orange yellowish tinged, 176–189 μ m high and 163–168 μ m broad, not interspersed, I-, KI-. **Hypothecium** pale yellowish, 6–8 μ m high. **Asci** 6–8 sporate. **Ascospores** hyaline, 18–21-transseptate, ellipsoidal, 96–105 x 10–12 μ m, I + blue.

Chemistry– Norstictic and con-norstictic acids present.

Specimens examined–Tamil Nadu: Anamalai hills, Topslip, M.B. Nagarkar & U.V. Makhija, 82.142, 82.173 (AMH).

Remarks–*Graphis marginata* resembles *G. congesta* in respect of external morphology and exciple nature. However, *G. congesta* has much smaller ascospores of 50–75 x 9–15 μ m in size and only norstictic acid in its thallus. *G. marginata* was previously reported from Brazil and is here reported for the first time from India. In India this species has been collected in semi-evergreen forest at higher elevation.

Graphis nigrocarpa Adaw. & Makhija sp. nov.

Figure 7

Similis Graphis kollaimalaiensis sp. nov. sed lirellis longioribus et ascosporis angustibus differt.

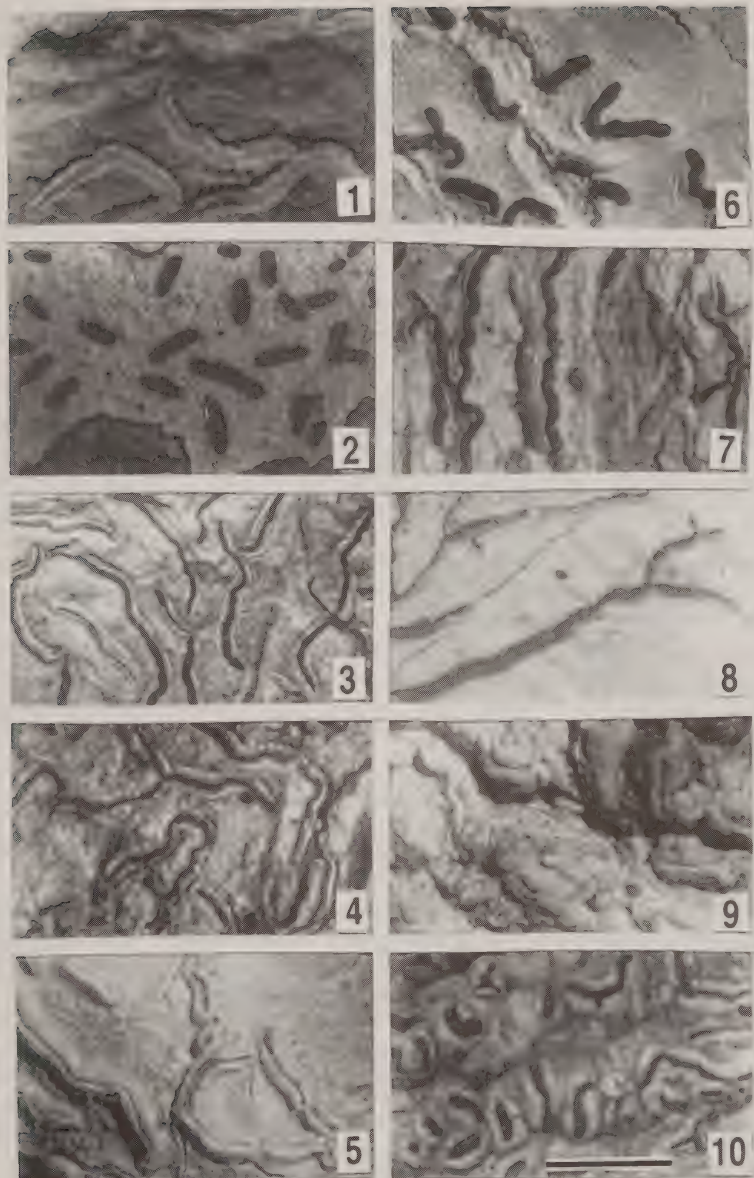
Etymology: from the Latin *niger*, black and from Greek *karpos*, fruit, a reference to black lirellae.

Holotype–India, Tamil Nadu, Munnar to Kodai, 24.1.1976, M.B. Nagarkar & K.D. Gole, 76.623; holotype: AMH.

Thallus dull yellow, yellowish buff, unevenly thickened, delimited by thin black hypothallus. **Ascomata** lirelline, 1–10 mm long and 0.1–0.2 mm broad, black, simple to irregularly branched, flexuose, immersed to slightly raised, terminally acute to subacute. **Disc** narrow, indistinct. **Exciple** present at the base, convergent, covered by a thalline margin up to the top, crystals studded, not striate, completely carbonized. **Epithecium** hyaline, thin, K-. **Hymenium** hyaline, clear to sometimes interspersed with crystals, 126–168 μ m high and 84–168 μ m broad, I-, KI-. **Hypothecium** hyaline, 6–8 μ m high. **Asci** 4–6 sporate. **Ascospores** hyaline, 8–14-transseptate, ellipsoidal, 33–63 x 4–6 μ m, I + blue.

Chemistry– Norstictic acid present.

Specimens examined–Tamil Nadu: Munnar to Kodai, M.B. Nagarkar & K.D. Gole, 76.586, 76.587, 76.113 (AMH).



Figures 1-10. Habit. 1. *Graphis albidofarinacea*, 2. *G. cinnamomea*, 3. *G. colliculoides*, 4. *G. flavens*, 5. *G. marginata*, 6. *G. kollaimalaiensis*, 7. *G. nigrocarpa*, 8. *G. nilgiriensis*, 9. *G. induta*, 10. *G. verruciformis*.
Bar = 2mm

Remarks—*Graphis nigrocarpa* differs from *G. kollaimalaiensis* in having much larger (up to 10 mm long) irregularly branched ascomata and has narrower ascospores. This species has been collected in montane forest.

Graphis nigrocarpa can easily be separated from *G. rustica* Kremp. by the presence of stictic acid, slightly larger ascospores (66–76 x 9–10 µm) and more number of locules (16–18 locules) of the ascospores in *G. rustica*.

The new species seems to be very similar to *Graphis catherinae* but that species lacks lichen substances.

***Graphis verruciformis* Adaw. & Makhija sp. nov.**

Figure 10

Similis Graphis congesta (Fée) Müll. Arg. *sed ascosporis minoribus differt.*

Etymology: from the Latin *verruca*, wart; a reference to warty thallus.

Holotype—India, Kerala, near Chinnar, Munnar to Udumalpet, 19.10.1985, P.G.

Patwardhan & M.B. Nagarkar, 85.1756; holotype:AMH.

Thallus dull grayish green, smooth to thick, finely and distinctly cracked, rough, distinctly warty. **Ascomata** lirelline, 1–4 mm long, 0.1 mm broad, black, simple, semi-emergent, scattered, terminally acute to obtuse. **Disc** narrow to moderately broad, dark blackish brown, pruinose. **Exciple** present at the base, convergent, covered by a thalline margin up to the top, not striate, completely carbonized. **Epithecium** hyaline, thin, K-. **Hymenium** hyaline, not interspersed, 110–130 µm high and 150–190 µm broad, I-, KI-. **Hypothecium** hyaline, thin. **Asci** 8 sporate. **Ascospores** hyaline, 6–12-transseptate, ellipsoidal, 37–50 µm x 4–6 µm, I + blue.

Chemistry—Norstictic acid present.

Remarks—*Graphis verruciformis* differs from the closely related *G. congesta* in having smaller ascospores of 37–50 µm x 4–6 µm. In *Graphis congesta* ascospores are rather larger of 50–75 µm long.

Appendix

***Graphis flavens* Müll. Arg., Flora 85: 334, 1882.**

Figure 4

Thallus yellowish green, uneven, cracked, delimited by thin, black hypothallus. **Ascomata** lirelline, 1–2.5 mm long, narrow, mostly simple to occasionally branched, concolorous with the thallus, scattered, immersed to semiemergent, irregularly curved, flexuose, terminally obtuse. **Disc** narrow, black, epruinose. **Exciple** present at the base, convergent, covered by a thalline margin upto the top, crystal studded, not striate, completely carbonized. **Epithecium** brownish, thin, K-. **Hymenium** hyaline, not interspersed, 97–105 µm high and 100–105 µm broad, I-, KI-. **Hypothecium** hyaline, 8–12 µm thick. **Asci** 8 sporate. **Ascospores** hyaline, 14–18-transseptate, ellipsoidal, 29–63 x 8–12 µm, I+ blue.

Chemistry—No lichen substances present.

Specimens examined—Tamil Nadu: Agasthi hills, Upper Kodayar, on road side tree, on Kakachi road, elev. approx. 1400 m., P.G. *Patwardhan & P.K. Sethy*, 84.76, near Chinnar, Munnar-Udumalpet, M.B. *Nagarkar & P.G. Patwardhan*, 85.1751 (AMH).

Remarks—*Graphis flavens*, a species previously reported from Java, is reported for the first time from India. This species has been collected in undisturbed forest at higher elevation, in montane forest.

***Graphis nilgiriensis* Adaw. & Makhija sp. nov.**

Figure 8

Similis Graphis proserpens Vain. sed excipulo omnino carbonaceo differt et acidum sticticum continens.

Etymology: from the Latin *ensis*, a place of origin, and Nilgiri, the type locality.

Holotype—India, Tamil Nadu, Nilgiri hills, Naduvattam, in Shola forest, app. 5000 ft., 25.2.1978, P.G. Patwardhan, 78.109; holotype:AMH.

Thallus yellowish green, thick, smooth, glossy, delimited by thin, black hypothallus. **Ascomata** lirelline, 1–5(–7) mm long and 0.1 mm broad, simple to branched, black, raised, scattered, narrow, terminally acute to subacute. **Disc** narrow to somewhat broader. **Exciple** convergent, covered by a thick thalline margin till the top, striate, 5–6 striae on each side, striae fused, much expanded at the apical region, completely carbonized. **Epithecium** hyaline, thin. **Hymenium** hyaline, not interspersed, 60–70 µm high and 120–149 µm broad, I–, KI–. **Hypothecium** indistinct. **Asci** 8 sporate. **Ascospores** hyaline, 9–13-transseptate, ellipsoidal, 38–42 x 4–6 µm, I+ blue.

Chemistry—Stictic acid present.

Remarks—*Graphis nilgiriensis* is characterized by its stramineous thallus; conspicuous, black, narrow, semi-emergent ascomata; striate, completely carbonized exciple; 38–42 µm long ascospores and presence of stictic acid. It resembles to *Graphis proserpens* in gross morphology, but differs from the latter in having completely carbonized exciple and fewer striae. *G. proserpens* has partially carbonized and multistriate exciple. *G. persulcata* Stirt., which resembles closely to the present species, however, lacks lichen substances. This lichen has been collected from evergreen montane forest.

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Four species of *Caloplaca* (*Teloschistaceae*, lichenized Ascomycota) new to Poland

KARINA WILK¹ & ADAM FLAKUS²

¹*palka@ib-pan.krakow.pl* ²*flakus@ib-pan.krakow.pl*

Laboratory of Lichenology, W. Szafer Institute of Botany
Polish Academy of Sciences, Lubicz 46, PL-31-512 Kraków, Poland

Abstract — The species *Caloplaca conciliascens*, *C. obliterans*, *C. percrocata* and *C. vitellinaria* are reported as new to the lichen biota of Poland. All of them were collected in the Polish Carpathians, mainly in the Tatra mountains. Detailed taxonomic descriptions and comments are provided.

Key words — lichenized fungi, taxonomy, geographical distribution

Introduction

The lichen genus *Caloplaca* Th. Fr. has been the subject of taxonomic surveys by many authors. Most recently European species of the genus were studied in detail by Giralt et al. (1992), Laundon (1992a), Nimis (1992), Roux & Navarro-Rosinés (1992), Søchting (1994), Navarro-Rosinés & Roux (1995), Navarro-Rosinés & Hladun (1996), Søchting & Stordeur (2001) and Khodosovtsev (2001, 2002), Arup (2006). North American *Caloplaca* species have been investigated by Arup (1992ab, 1993ab, 1994, 1995ab), Wetmore (1994, 1996a, 2001, 2003, 2004) and Wetmore & Kärnefelt (1998, 1999). Antarctic species are also fairly well known (e.g., Søchting & Øvstedal 1992; Olech & Søchting 1993; Søchting & Olech 1995, 2000). Polish species of the genus have not been investigated in detail, however, and are in need of taxonomic revision. Currently 67 taxa have been reported from Poland (Nowak & Tobolewski 1975, Fałtynowicz 2003), approximately 50 of which occur in the Polish Carpathians (Bielczyk 2003). New records of *Caloplaca* for Poland have recently been supplied by Kossowska (1999), Zalewska (2000), Bielczyk (2003), Sparrius (2003), and Ceynowa-Giełdon & Adamska (2005).

The paper is based mainly on collections made by the second author during fieldwork in the Polish Tatra Mts. in 2002–2004. The study area plays an important role for the preservation of biological diversity including lichens, not only in Poland but also on a European scale. Despite the long tradition of lichenological research in the Polish Tatra Mts., many species are still being discovered from the area (e.g., Bielczyk 2003, Czarnota 2004, Flakus 2004, Krzewicka 2004, Kukwa 2004, Flakus & Bielczyk 2006, Śliwa 2006).

The present paper contributes to the study of the genus *Caloplaca* in Poland and expands the knowledge of lichen diversity in the Polish Carpathians. Detailed taxonomic descriptions and comments are presented below.

Taxonomic Descriptions

Caloplaca conciliascens (Nyl.) Zahlbr.

FIGURE 1a

Catal. Lich. Univ. 7, p. 109 (1931)

Thallus small, indistinct, areolate, greyish white. Apothecia sessile, clustered, angular, 0.5–1.0 mm diam. Disc flat to slightly convex, brownish red. Margin persistent, thin, slightly flexuose, black. Parathecium without algae, inside colourless, outside blackish green. Epithymenium brownish golden; hymenium hyaline, 60–75 μm ; hypothecium hyaline, with oil drops, ca. 80 μm ; paraphyses simple or with some branches in upper parts, tips with 1–2 slightly swollen cells. Spores 8 per ascus, 10–14 $\times$ 5–7 μm , isthmus 3–4(–5) μm .

Spot test reactions: thallus K–, cN+ weakly violet (leccidea green); apothecial margin K+ violet red, cN+ distinctly violet (leccidea green), H+ intensifying green; epithymenium K+ violet red; upper parts of paraphyses H+ weakly greenish.

Ecology — At the collection site, *C. conciliascens* grew on mylonitized granite rock in shady place in the subnival belt of Tatra Mts. It was accompanied by *Lecanora cenisia* Ach.

Geographical distribution — The species is known from Austria (Wunder 1974, Hafellner & Türk 2001), Italy (Nimis 1993) and Turkey (John 1996).

Comments — *Caloplaca conciliascens* is characterized by a reddish black apothecial disc and brownish black margin. Wunder (1974) treated this taxon in the study on saxicolous species of *Caloplaca* with black coloured apothecia. The group of lichens is not homogeneous and this particular species has been considered as a member of *C. ferruginea* group (Wunder 1974, Kärnefelt 1989). Wetmore (1996a) discussed *C. conciliascens* in his taxonomic treatment of *C. siderites* group in North and Central America. He concluded that *C. conciliascens*, *C. exsecuta* (Nyl.) Dalla Torre & Sarnth., *C. concilians* (Nyl.) H. Olivier, *C. litoricola* Brodo and *C. britzelmayri* (Hue) Zahlbr. are probably closely related and form one distinct group characterized by presence of “dark apothecial margin and leccidea green instead of thalloidima green” (Wetmore 1996a).

Caloplaca conciliascens is very similar to *C. exsecuta*, which is a fairly common species distinguished by a very thin, sometimes almost disappearing thallus, flat to strongly convex apothecia, higher hymenium (65–135 μm) and a hypothecium (50–125 μm), which is always brownish coloured with numerous oil drops and wider spores (5.5–8.0 μm) (Wunder 1974).

Other related species are: *C. concilians* that differs from *C. conciliascens* in having abundant algae in the apothecial margin, *C. britzelmayri* with dirty yellowish apothecium disc, larger spores that occupies calcareous rocks, and *C. litoricola*, which besides distinctive characters of the apothecia is a maritime species known from western coast of North America (Wetmore 1996a,b). Clauzade & Roux (1985) regarded the taxon as closely related to *C. conversa* (Kremp.) Jatta. *Caloplaca conversa* in comparison with *C. conciliascens* produces smaller apothecia of different anatomy – margins usually lecanorine, with distinct oval cells, never black or greenish coloured (Wunder 1974). The two species differ also due to their chemistry (see Wetmore 1996a).

SPECIMEN EXAMINED — POLAND, WESTERN CARPATHIANS, Tatry Wysokie Mts., Ciemnosmreczyńska Przełęczka pass, N aspect, slope 30°, mylonite area, subnival belt, alt. 2115 m, 49°11'21"N, 20°02'59"E, on mylonite rock, 7 August 2004, A. Flakus 3046 (KRAM).

Caloplaca obliterans (Nyl.) Blomb. & Forssell
Points-Förteckning, p. 69 (1880)

FIGURE 1b

Thallus small, more or less irregularly shaped in outline, areolate, pale to dark orange. Areoles irregularly shaped, often minutely lobed, plane to convex, scattered or huddled in groups. Hypothallus thin, concolorous with thallus, characterized by dendritic extensions to rock cracks. Soralia in the centre of thallus, concave and eroded, yellowish orange. Apothecia numerous in the centre of thallus, partially innate or adnate, small, up to 0.5 mm diam. Disc flat to slightly convex, orange, surrounded by thin, concolorous or slightly lighter margin. Amphithecium with algae. Epihymenium brownish golden; hymenium hyaline, 50–65 µm; hypothecium hyaline, 40–50 µm; paraphyses with some branches, tips with 1–2 swollen cells, up to 5 µm diam. Spores 10–11.5 × 4 µm, isthmus 2–3 µm.

Spot test reactions: thallus K+ violet red; apothecial margin cN–; epihymenium K+ violet red.

Ecology — At the collection site the species occupied a typical niche, viz.: an overhanging granite wall, in moist and shady place. It was accompanied by *Buellia alboatra* (Hoffm.) Th. Fr., *Lecanora dispersa* (Pers.) Sommerf., *Pseudosagedia chlorotica* (Ach.) Hafellner & Kalb and *Xanthoria elegans* (Link.) Th. Fr. The species is characteristic for the silicate community *Caloplacetum obliterantis* Wirth 1972 (see Wirth 1972, Obermayer 1993).

Geographical distribution — According to Wirth (1995) the species occurs in Europe in boreal to montane and high montane zones of temperate zone. It was reported from Iceland (Orange 1990), Norway, Sweden, Finland, Russian Fennoscandia (Nordin 1972), United Kingdom (Wade 1965, Laundon 1992b, Coppins 2002), Denmark (Søchting & Alstrup 2002), Czech Republic (Vězda & Liška 1999), Slovakia (Pišút 1995, Pišút et al. 1996, Lisická 2005), Ukraine (Kopachevskaya 1986, Oksner 1993), Germany (Wirth 1995), Austria (Obermayer 1993), Romania (Kondratyuk et al. 2003), Hungary (Verseghegy 1971), Bulgaria (Mayrhofer et al. 2005), Italy (Nimis 1993), France (Harmand 1913, Ozenda & Clauzade 1970), Portugal (Llimona & Hladum 2001) and Spain (Etayo 1990). Besides Europe it occurs in Southwest Asia in Israel (Alon & Galun 1971) and Jordan (El-Oqlah 1992), in North America (Esslinger 1997, Fryday et al. 2001) and in Australia (Kalb 1996).

Comments — *Caloplaca obliterans*, as a minutely lobate species containing anthraquinones, was included by Nordin (1972) in the *Caloplaca* subgen. *Gasparrinia*. More recently, Wetmore & Kärnefelt (1998) carried out a revision of the lobate and subfruticose species of *Caloplaca* in North and Central America. The authors discussed the species in the paper but did not find any specimens of that taxon in the studied material.

According to Wetmore & Kärnefelt (1998), *C. obliterans* should not be included in subgen. *Gasparrinia* as it does not develop distinct elongated lobes.

Caloplaca obliterans resembles *C. cirrochroa* (Ach.) Th. Fr., *C. proteus* Poelt and *C. decipiens* (Arnold) Blomb. & Forssell, but those species occur on calcareous substrate. There are also some morphological differences between the taxa: *C. cirrochroa* and *C. proteus*, have a thallus consisting of more convex and longer lobes in comparison with *C. obliterans* and *C. decipiens* has rather lip-shaped or capitate soralia.

Moreover, Arup (1993a, 1995a) compared *C. obliterans* with two other sorediate species, i.e. *C. flavogranulosa* Arup and *C. citrina* (Hoffm.) Th. Fr. However, *C. obliterans* is well distinguishable due to the dark orange colour of thallus, concave and eroded soralia as well as distinct, dendritic hypothallus (Arup 1993a, 1995a).

Caloplaca obliterans has been reported from many European countries where it is usually collected in sterile form. The apothecia, which develop very rarely, are small, only up to 0.5 mm diam. Our collection of *C. obliterans* has a lower hymenium and hypothecium when compared to those provided by Alon & Galun (1971) – 70–90 µm and ca. 90 µm, respectively. Moreover, it is worth noting that our specimen is partly fertile and so has more aggregated areoles lacking soralia and a poorly developed hypothallus.

SPECIMEN EXAMINED — POLAND, WESTERN CARPATHIANS, Tatry Wysokie Mts., Dolina Rybiego Potoku valley, Mokra Wanta, in moist and shaded place, WNW aspect, alt. 1750 m, on overhanging granite wall, 17 August 2002, A. Flakus 83 (KRAM).

REFERENCE MATERIAL EXAMINED — J. J. Havaas, Lich. Norv. Occid. 218 (KRAM).

Caloplaca percrocata (Arnold) J. Steiner

FIGURE 1c

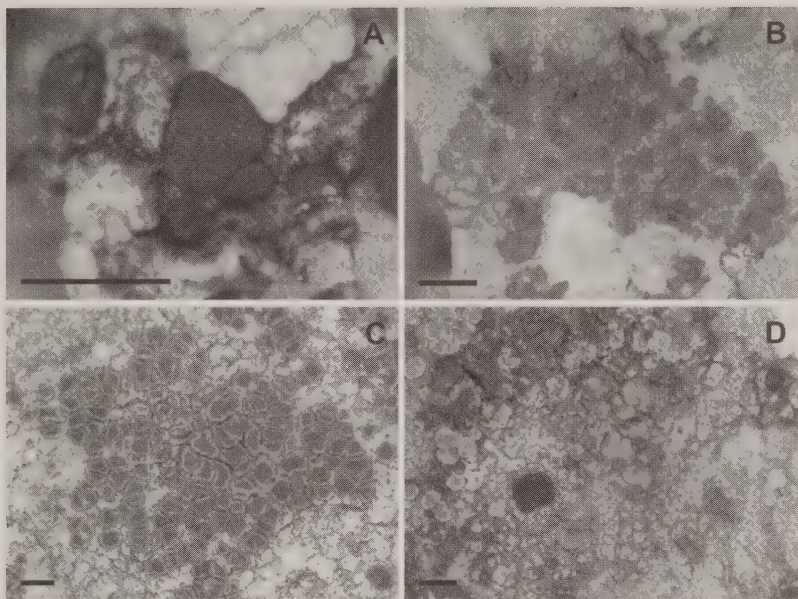
Halácsy in Denkschrift. Math.-naturw. Classe Kais. Akad. Wiss. Wien, vol. LXI, p. 523 (1894)

Thallus thick or thin, areolate, whitish grey, sometimes with a tinge of bluish or brownish. Areoles irregular, with uneven surface, subfarinose, plane to convex, up to 3 mm diam. Hypothallus thin, dark grey and rather rarely visible. Apothecia numerous in the centre of thallus, aggregated in groups, 0.4 to 1.3 mm diam, often angular to flexuose, sessile from the beginning. Disc flat, dark, brownish orange to brownish red, contrasting with pale, yellowish orange, thick margin. Thalline margin pale yellow, soon excluded (only sometimes good visible). Parathecium with radiating hyphae; amphithecium with numerous algae. Epithymenium brownish golden; hymenium hyaline, up to 100 µm; hypothecium hyaline, with oil droplets, ca. 60 µm; paraphyses with some branches. Spores 15–18(–20) × 8–10(–12.5) µm, isthmus 3–4(–5) µm.

Spot test reactions: thallus K–, C–, cN+ weakly violet (thalloidima green); epithymenium K+ violet red. The thallus contains the anthraquinone 7-chloroemodin (detected by U. Søchting).

Ecology — At the collection site the lichen occurred on base-rich siliceous shale on steep slopes in exposed places in the alpine belt. It was accompanied by *Aspicilia* sp., *Eiglera flavida* (Hepp) Hafellner, *Polyblastia cupularis* A. Massal. and *Thelidium* sp.

Geographical distribution — The species was reported from Norway (Santesson et al. 2004), Austria (Poelt 1960, Hoffmann et al. 1998, Türk & Berger 1999), Hungary (Verseghegy 1994), Bulgaria (Mayrhofer et al. 2005), Ukraine (Kopachevskaya 1986,



Figs. 1 A-D. Species of *Caloplaca*. A: *C. conciliascens* (A. Flakus 3046 KRAM); B: *C. obliterans* (A. Flakus 83 KRAM); C: *C. percrocata* (A. Flakus 151 KRAM). D: *C. vitellinaria* (A. Flakus 5120 KRAM).
Scale bar = 1 mm.

Oksner 1993), Croatia (Kušan 1953), Italy (Nimis 1993), France (Ozenda & Clauzade 1970, Roux 1976, Houmeau & Roux 1991), Spain (Egea 1984) and Portugal (Llimona & Hladun 2001). Additionally, the species was reported by Kondryatuk et al. (2004) from France, Byelorussia, Turkey and North Africa.

Comments — According to Magnusson (1944a) *C. percrocata* belongs to the *C. ferruginea* group which consists of taxa closely related to *C. ferruginea* (Huds.) Th. Fr. and united by ferrugineous coloured apothecia. Moreover, the species of the *C. ferruginea* group are characterized by containing the chemosyndromes based on 7-chloroemodin (see Söchting & Tønsberg 1997, Elix et al. 2000). This group is rather large and includes species representing all ecological groups of lichens, for example corticolous, lignicolous, muscicolous and saxicolous (Magnusson 1944a,b, Clauzade & Roux 1985, Roux & Navarro-Rosinés 1992).

More recently Wetmore (1996a) established a more restricted *C. siderites* group in which *C. percrocata* was included. This group consists of exclusively saxicolous species characterized by grey, whitish or brown thalli that lack anthraquinones with apothecia that are red or orange and do contain anthraquinones. Furthermore, Wetmore (1996a) reported the non-crystallizing pigment thalloidima green in most of the treated species, including *C. percrocata*. This pigment reacts with K, cN, 10% N, C and concentrated HCl giving a violet colour.

Caloplaca percrocata is a rather characteristic taxon due to the prominent apothecia and the usually distinct areolate thallus. It could be confused with *C. teicholyta* (Ach.) J. Steiner, which has a scurfy-granular to sorediate surface of thallus (not at all or weakly areolate), uniformly red coloured apothecia with usually well visible white thalline margin.

Caloplaca erythrocarpa (Pers.) Zwackh differs in producing smaller and also uniformly red apothecia.

The species *C. atroflava* (Turner) Mong. and *C. submergenda* (Nyl.) H. Olivier may also be considered similar to *C. percrocata* but they differ in ecological preferences (both are acidophilous and hygrophilous) and some morphological details. *Caloplaca atroflava* forms dark grey thallus and apothecia without any thalline margin while *C. submergenda* has apothecia with persistent, greyish thalline margins and produces considerably smaller spores (Clauzade & Roux 1987).

Another acidophilous species, *C. limitosa* (Nyl.) H. Olivier, was also considered as possible to be mistaken with *C. percrocata* (see Nimis 1993). A detailed description of *C. percrocata* is available in several papers, e.g. Magnusson (1944a), Oksner (1993), Wetmore (1996a) and Kondryatuk et al. (2004).

SPECIMENS EXAMINED — POLAND, Western Carpathians, Tatry Zachodnie Mts., Twardy Uplaz, N slope below Ciemniak Mt., alt. 1900 m, 49°14'12"N 19°54'12"E, on siliceous shale contains calcium, 30 August 2002, A. Flakus 151 (C, KRAM, MIN); and 9 July 2004, A. Flakus 2251 with K. Palka & B. Cykowska (KRAM); the duplicates of the specimen will be distributed by Wetmore in Telosch. Exs. Fasc. 4).

REFERENCE MATERIAL EXAMINED — Poelt, Lich. Alp. no. 50 (KRAM).

Caloplaca vitellinaria Szatala

FIGURE 1d

Ann. Hist.-Nat. Mus. Natl. Hungarici, ser. nov. 7, p. 276 (1956)

Thallus absent or very scanty, pale orange, over the thallus or apothecia of the host *Candelariella vitellina* (Hoffm.) Müll. Arg. Apothecia numerous, usually grouped and then angular, up to 1 mm diam. Disc flat to slightly convex, orange. Margin thin, paler than disc, flush and only in young apothecia slightly raised. Parathecium with radiating hyphae; amphithecium with numerous algae. Epihymenium brownish golden; hymenium hyaline, 60–70 µm; hypothecium hyaline, ca. 30 µm; paraphyses with branches, tips with 1–2 swollen cells, up to 5 µm diam.; spores 9–14 × 5–8 µm, isthmus (3–)4–5 µm.

Spot test reactions: thallus K+ violet red; epihymenium K+ violet red; hymenium I+ blue; hypothecium, parathecium and amphithecium I–.

Ecology — At the collection site the lichen colonized the thallus of *Candelariella vitellina* on sandstone and shale containing calcium in lower montane and alpine belts of Polish West Carpathians. It was accompanied by *Acarospora* sp., *Lecanora dispersa* and *Lecidella stigmatea* (Ach.) Hertel & Leuckert.

Geographical distribution — The species is known from Slovakia (Pišút et al. 1996, Lisická 2005), Austria (Hafellner & Türk 2001), Hungary (Szatala 1956), the Iberian Peninsula (Llimona & Hladun 2001) and Turkey (John 1996).

Comments — *Caloplaca vitellinaria* is a parasitic species occurring on the thallus of *Candelariella* spp., e.g. *C. vitellina*, *C. coralliza* (Nyl.) H. Magn. (Szatala 1956, Poelt

1969, Wirth 1995, Hafellner 2001). *Caloplaca grimmiae* (Nyl.) H. Olivier is another taxon colonising *Candelariella* spp., but it differs significantly by the colour of apothecia, which have reddish brown discs with blackish brown margins.

Caloplaca vitellinaria was treated by Clauzade & Roux (1985) in connection with the *C. ferruginea* group and was accepted by the authors at variety level of *C. holocarpa* (Hoffm.) A.E. Wade. The primary differences between *C. vitellinaria* and *C. holocarpa* apparently are their ecology, although there are some other distinguishing characters such as size and arrangement of apothecia (bigger and aggregated in case of *C. vitellinaria*).

Caloplaca vitellinaria is similar to *C. insularis* Poelt but the latter taxon has better developed thallus and smaller apothecia (up to 0.8 mm diam.) with medulla reacting distinctly I+ violet. Moreover, *C. insularis* is parasitic on the *Aspicilia* spp., i.e. *A. candida* (L.) Körb. (Poelt 1960), *A. polychroma* Anzi (Clauzade & Roux 1985).

It is worth noting that in the specimens of *C. vitellinaria* examined, both collected by us and A. Vězda, a considerably low hymenium (ca. 80 µm) was observed compared to the original description where it reaches ca. 100–125 µm (Szatala 1956).

SPECIMENS EXAMINED — POLAND, Western Carpathians: Beskid Śląski Mts., Pasma Baraniej Góry range, Pietraszyna village, Koczy Zamek Mt., in open, sunny place, alt. 847 m, 49°32'54"N 18°58'32"E, on calcareous sandstone, 9 September 2005, K. Wilk 3838 (KRAM); Tatry Zachodnie Mts., Twardy Upłaz, N slope below Ciemniak Mt., alt. 1900 m, 49°14'14"N 19°54'13"E, on siliceous shale contains calcium, 30 July 2005, A. Flakus 5120 (KRAM).

REFERENCE MATERIAL EXAMINED — HUNGARY, VESPREM: supra balneas Tihany prope lacum Balaton, alt. 220 m, 17 August 1964, A. Vězda (KRAM-L-28050).

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The status of *Psilocybe floridana* (Strophariaceae) in *Callistosporium* (Tricholomataceae)

ETELVINA GÁNDARA
& GASTÓN GUZMÁN

gandara@ecologia.edu.mx
guzmang@ecologia.edu.mx
Instituto de Ecología

Apartado Postal 63, Xalapa 91000, Veracruz, Mexico

Abstract— Evidence is presented indicating that the type specimen of *Psilocybe floridana* is the same type of *Callistosporium psilocybe* and that both names are synonyms of *C. luteoolivaceum*.

Keywords— synonymy, intracellular pigment

Introduction

During the study of type specimens of *Psilocybe* (Fr.) P. Kumm. for a second edition of the monograph on the genus *Psilocybe* (Guzmán 1983), we found that the type of *P. floridana* (Murrill 1945) does not belong to *Psilocybe*, as Guzmán (1983) previously stated. Guzmán had previously considered that Murrill's fungus was a *Psathyrella* sp. However, the intracellular pigment in the spores, basidia and hyphae, lack of clamp connections, and lack of a germ pore on the spores for *P. floridana* indicates this species is actually a *Callistosporium* Singer (1944). Notwithstanding, Singer (1944) had not considered Murrill's species when he, together with Murrill (Singer 1944), described *C. psilocybe*. Singer (1946, 1970) maintained this position in subsequent papers. Interestingly, the specimens used for the description of *C. psilocybe* are the same ones that were used for the description of *Psilocybe floridana*. Singer (1946) considered *C. psilocybe* as a synonym of *C. luteoolivaceum*. In this paper we discuss the synonymy of *Psilocybe floridana* with *Callistosporium luteoolivaceum*.

Materials and methods

Available specimens of *Psilocybe floridana* and *Callistosporium luteoolivaceum* from FH, FLAS and MICH were studied. Microscopical study was made with sections of each basidioma mounted in 5% KOH, 3% NH₄OH and 1% Congo red (previously treated with 96% alcohol for rehydration). Spore shape was based on the quotient (Q), obtained from the length : width ratio following Bas (1969).

**Both *Psilocybe floridana* and *Callistosporium psilocybe* have
the same holotype and synonyms of *C. luteoolivaceum***

Callistosporium luteoolivaceum (Berk. & M.A. Curtis) Singer, Lloydia 9: 117, 1946.

Figs. 1-6

== *Agaricus luteoolivaceum* Berk. & M.A. Curtis, Ann. Mag. Nat. Hist. III 4: 286, 1859.

== *Collybia luteoolivaceum* (Berk. & M.A. Curtis) Sacc., Syll. Fung. 5: 215, 1887.

= *Callistosporium psilocybe* Murrill & Singer, in Singer, Mycologia 36: 363, 1944.

= *Psilocybe floridana* Murrill, Proc. Fl. Acad. Sci. 7: 126, 1945.

Non *Stropharia floridana* Murrill, Mycologia 35: 536, 1943, according to the study of the type in FLAS: Murrill 8738 (FLAS-10170).

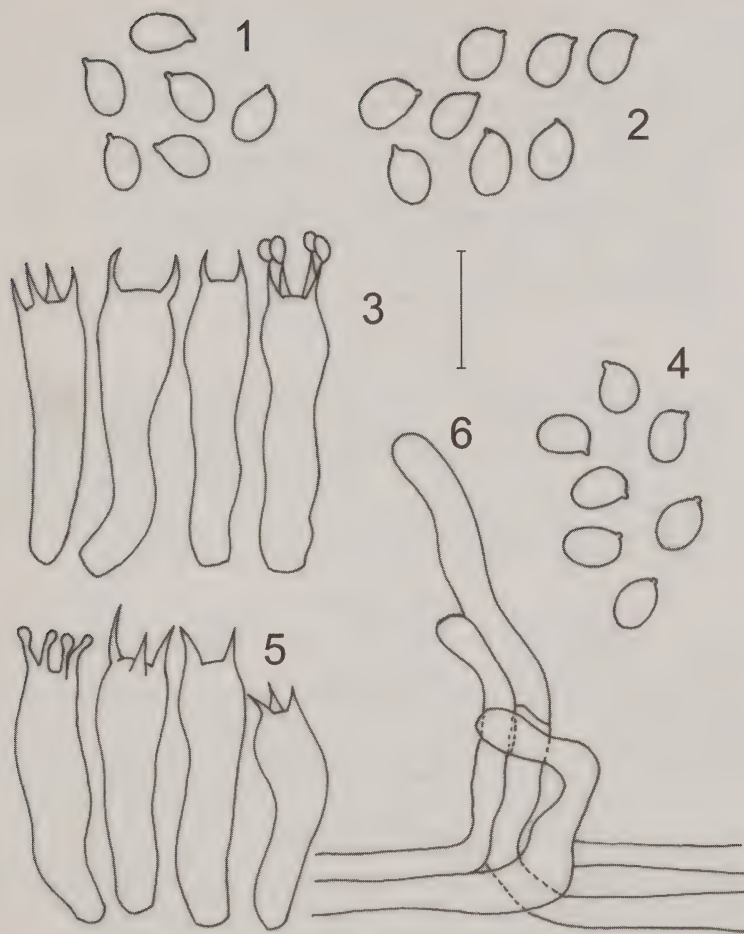
For other synonyms, see Redhead (1982)

For a complete description, see Singer (1970). However, as the basidiomata show a wide variation in form and color, we present here some additional morphological features of the pileus, based on a study of the type of *Psilocybe floridana*, which includes a color drawing by Murrill at FLAS. The pileus is subcampanulate or convex to plane-convex, finally subumbilicate or umbilicate. All the basidiomata are yellowish-melleous to dark vinaceous brown as dried. The following microscopic features were observed: *spores* (4-) 4.5-5.5 (-6) x 3-4.5 μ m, Q = (1.1-) 1.2-1.6, broadly ellipsoid to ellipsoid, occasionally subglobose, **without germ pore**, thin-walled, smooth, hyaline or with a brownish vinaceous content, inamyloid. *Basidia* 20-28 (-30) x 4.5-7 μ m, 4-spored, cylindric-clavate, flexuous, thin-walled, hyaline or with same pigment as the spores. *Pleurocystidia* absent. *Cheilocystidia* absent. *Subhymenium* not differentiated or composed of parallel hyphae, 1.5-2 (-3) μ m wide, thin-walled, hyaline or brownish vinaceous from intracellular pigment. *Hymenophoral trama* regular, hyphae 3-7 μ m wide, thin-walled, hyaline or with brownish vinaceous intracellular pigment. *Pileipellis* with hyphae radially arranged, repent, (3.5-) 5-7 (-10) μ m wide, thin-walled, hyaline or with brownish vinaceous intracellular pigment. *Stipitipellis* a cutis, occasionally disrupted by small clusters of ascending hyphae, 3-7 μ m wide, thin-walled, hyaline. *Clamp connections* absent.

Habitat and Distribution—According to Singer (1944, 1946, 1970), Murrill (1945), Dennis (1951), Redhead (1982), Pegler (1983), Moser (1984) and Hongo (1989), this fungus is reported from North America, South America, the Caribbean, Europe and Asia. However, it seems that the concept of *C. luteoolivaceum* accepted by those authors encompasses several species, both temperate and tropical. A critical revision of some synonyms is necessary.

This fungus is reported on wood (logs, trunks and stumps) or rotting wood, frequently covered by mosses, rarely in soil, in temperate, subtropical and tropical forests. Pulido & Boekhout (1989) cited *P. aff. floridana* from Colombia, in high mountains.

Discussion—This collybioid fungus was considered as a *Collybia* by Saccardo (1987) and also by Murrill in the herbarium in the holotype of *Psilocybe floridana*. The basidiomata are also similar to a *Psilocybe* or *Psathyrella*. However, the intracellular pigment in spores, basidia and hyphae is the main feature to consider the species as *Callistosporium*, following Singer (1944, 1946, 1970), and as discussed by Redhead (1982). The thin-walled, ellipsoid and hyaline to pigmented spores and the absence of



Figs. 1-6. *Callistosporium luteoolivaceum*. 1, 2, 4: spores. 3, 5: basidia, 6: stipitipellis (1: holotype; 2, 3: holotype of both *C. psilocybe* and *Psilocybe floridana*; 4, 5, 6: Singer F-2651). Scale bar 10 μ m.

a germ pore are important features. However, Singer (1970) described the spores of *Callistosporium luteoolivaceum* having a germ pore. Material from the Czech Republic in F (Singer & Pouzar C-5546, F-1018787) was identified by Singer as *Psilocybe floridana* but it is in fact *P. laetissima* Hauskn. & Singer (!). The confusion on the holotypes of both *Psilocybe floridana* and *Callistosporium psilocybe*, was because both Murrill (1944) and Singer (1944) published descriptions at the same time, based on the same herbarium material from Juniper Springs, in Marion Co., Florida, gathered by Murrill

on October 13, 1940 and recorded in FLAS as 19323. Halling (1986) listed the type of *P. floridana*: "Marion Co., Juniper Springs, 13 Oct 1940, Murrill, F-19323" and for *C. psilocybe*: "Juniper Springs, Oct, Murrill (Holotype: FH!; isotype: FLAS)" based on the protologues for both species together with data attached to specimens. In both descriptions of *P. floridana* and *C. psilocybe* it is noted that the fungus grows on an oak log in October, although Singer did not mention the year.

Studied Material. UNITED STATES, Florida: Marion Co., Juniper Springs, Oct. 13, 1940, Murrill s.n. (FLAS-19323, **HOLOTYPE** of *Psilocybe floridana* and **ISOTYPE** of *Callistosporium psilocybe*; FH, **HOLOTYPE** of *C. psilocybe*; MICH-12136, **ISOTYPE** of *Psilocybe floridana*); Gainesville, Jun. 8, 1943, Singer F-2651 (FH, as *C. psilocybe*).

Additional Material Examined. North Carolina: Curtis Herb., 1856, *Sprague* 962 (FH-5728, **HOLOTYPE** of *Agaricus luteoolivaceum*).

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We are grateful to Dr. Roy Halling (New York Botanic Garden) and Dr. Timothy J. Baroni (State University of New York) for their critical review. Dr. Dennis E. Desjardin (San Francisco State University) and Dr. Laura Guzmán-Dávalos (Universidad de Guadalajara, Mexico) gave useful comments to a preliminary version. Also we express our thanks to Curators of F, FH, FLAS and MICH for loaned important specimens and to Virginia Ramírez-Cruz for her help in some microscopic observations. Guzmán acknowledges the support of his institution to his research. We also thank Lorelei Norvell and Shaun Pennycook their editorial support.

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Three new species of *Stemphylium* from China

YONG WANG & XIU-GUO ZHANG *

zhxg@sdau.edu.cn

Department of Plant Pathology, Shandong Agricultural University
Taian, 271018, China

Abstract—Three new species of *Stemphylium* from China are described and illustrated: *S. pruni*, *S. plantaginis* and *S. capsici*. The type specimens are deposited in the Herbarium of the Department of Plant Pathology of Shandong Agricultural University (HSAUP).

Key words—hyphomycetes, dematiaceous

Introduction

Until now, about 150 *Stemphylium* taxa have been reported in the world, but only four new species have previously been described from China (Zhang & Zhang 2003). During the past few years, we have obtained numerous isolates of *Stemphylium* spp. from a large number of leaf spots derived from different plants. However, most isolates belonged to a few well-known species of *Stemphylium* such as *S. botryosum*, *S. solani* and *S. lycopersici*. This study presents a survey of *Stemphylium* species isolated from necrotic leafspots on *Prunus persica*, *Plantago major*, and *Capsicum annuum* in China.

Materials and Methods

Specimens of leaves with leafspots were collected from various zones in China during 2002–2005. All specimens were examined in the laboratory and then deposited in the herbarium of the Department of Plant Pathology, Shandong Agricultural University (HSAUP). Morphological comparisons of sporulation elements of *Stemphylium* spp. were based on cultures that developed under standardized conditions (Simmons 2001): potato-carrot agar (PCA) in plastic petri dishes, at ambient room temperatures 28°, and examined within 3–4 weeks. Microscope slides of superficial colony growth were prepared in a lactophenol and glycerin solution. The slides were examined and camera lucida drawings were prepared to show the most diagnostic characters. The taxonomic determinations were made from descriptions in the literature.

*Corresponding author

Taxonomic Description

Stemphylium pruni Yong Wang bis & X.G. Zhang, sp. nov.

FIGURE 1

Ex culturis in agaro 'potato-carrot' descripta. Coloniae effusae, pallide brunneae vel medio-brunneae. Mycelium superficiale, hyphae ramosae, septatae, pallide brunneae, laeves, 3.5-4.5 μm latae. Conidiophora solitaria, laevia, recta vel curvata, nonramosa vel raro ramosa, pallide brunnea, cylindrica, 4-7-septata, 87-134 $\times$ 3.5-4.5 μm , ad apicem in saepissime 1 proliferationis usque 6.0-7.5 μm , laevi. Conidia singularia in apice conidiophori et dein proliferationis cujusque successivae oriunda, pallide brunneae, oblonga-ellipsoidea vel oblonga, ad apicem subtruncata, ad basim rotundata vel subtruncata, recta, laevia, 1-3-transverse septata, 0-1 longitudinaliter septata, ad 1-2 distincte constricta, 17-44 $\times$ 11.5-24 μm .

Holotype: on leaves of *Prunus persica* (L.) Batsch, Arboretum of Guiyang, Guizhou Province, China. Aug. 16. 2003, Y. Wang, HSAUP III₀159.

Etymology: in reference to the host, *Prunus persica*

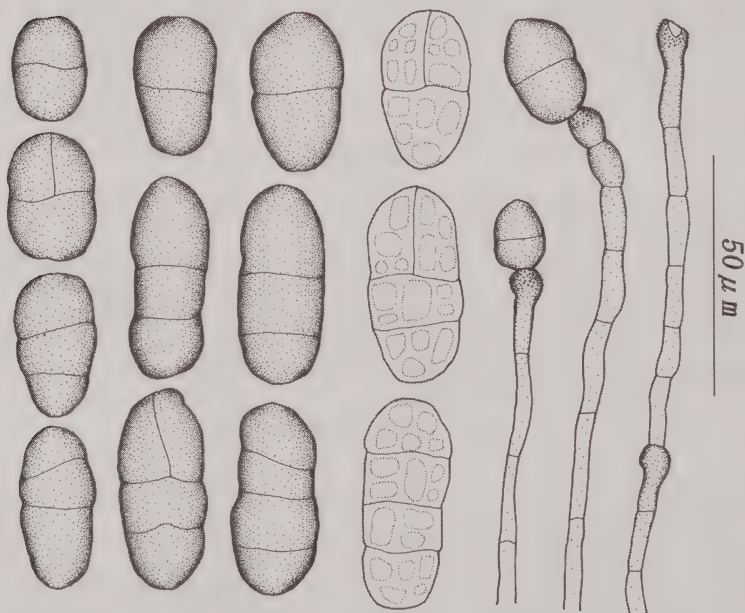


Fig. 1 Conidia and conidiophores of *S. pruni*

Colonies on PCA effuse, pale brown to medium brown. Mycelium superficial, hyphae branched, septate, pale brown, smooth, 3.5-4.5 μm wide. Conidiophores solitary, unbranched or occasionally branched, straight or slightly curved, light brown, cylindrical, swollen at the apex 6.0-7.5 μm diam and distinctly flared, 4-7-septate, 87-134 $\times$ 3.5-4.5 μm , smooth or occasionally echinulate near the proliferation pore. Conidia

develop singly through a wide pore at the apex of each conidiophore, pale brown, oblong-ellipsoid or oblong, subtruncate at the apex, rounded or subtruncate at the base, straight, smooth-walled, with 1-3 transverse septa and 0-1 longitudinal septum, and always with 1-2 distinct constrictions at the transverse septa, $17\text{--}44 \times 11.5\text{--}24\text{ }\mu\text{m}$ (av. $34.5 \times 18\text{ }\mu\text{m}$), L/W ratio is 1.5-2.4 (av. 1.9).

The conidia of this species are similar to those of *S. nabarii* (Sarwar & Srinath 1966). However, the conidial size range and L/W ratio (av. $35 \times 18\text{ }\mu\text{m}$, L/W=1.5-2.4) are smaller than those of *S. nabarii* (av. $44 \times 14\text{ }\mu\text{m}$, L/W=2.8-3.3). Some conidia of the new taxon have a longitudinal septum, while those of *S. nabarii* have no longitudinal septa. In addition, the conidiophores of the new taxon ($87\text{--}134\text{ }\mu\text{m}$) are longer than those of *S. nabarii* ($48\text{--}77\text{ }\mu\text{m}$).

***Stemphylium plantaginis* Yong Wang bis & X.G. Zhang, sp. nov.**

FIGURE 2

Ex culturis in agar 'potato-carrot' *descripta*. *Coloniae effusae, pallide brunneae vel brunneae. Mycelium superficiale ex hyphis ramosis, septatis, pallide brunneis, laevibus, 3.5-4.5* μm *crassis compositum. Conidiophora singula, recta vel curvata, nonramosa vel raro ramosa, pallide brunneae, cylindrica, 7-9-septata, 48-108* $\times$ *4.0-6.5* μm , *ad apicem in saepissime 2 proliferationis usque 6.5-12.0* μm , *laevibus. Conidia singularia in apice conidiophori et dein proliferationis cujusque successivae oriunda, brunneae, ovoidea, late ellipsoidea vel oblonga-ellipsoidea, ad apicem vel basim subtruncata, recta vel curvata, laevia, 1-2-transverse septata, 0-1 longitudinaliter septata, 26-54* $\times$ *16-26* μm .

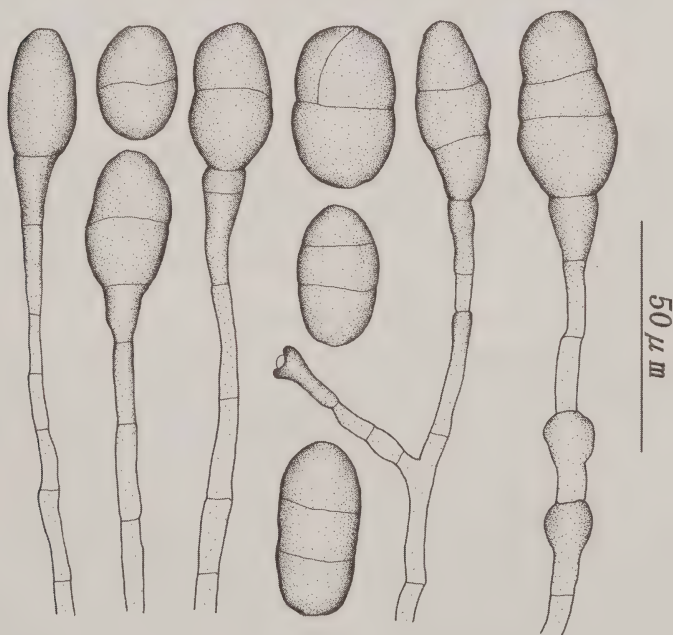


Fig. 2 Conidia and conidiophores of *S. plantaginis*

Holotype: on leaves of *Plantago major* L., Arboretum of Moutain Tai, Shandong Province, China. Oct. 5. 2003, Y. Wang, HSAUP III₀ 0532.

Etymology: in reference to the host, *Plantago major*

Colonies on PCA effuse, light brown to brown. Mycelium superficial, composed of branched, septate, pale brown, smooth, hyphae 3.5-4.5 μm wide. Conidiophores solitary, simple or occasionally branched, straight or slightly curved, light brown, cylindrical, 7-9-septate, 48-108 $\times$ 6.5-4.0 μm , swollen at the apex 6.5-12.0 μm diam and distinctly flared, smooth. Conidia develop singly through a wide pore at the apex of each conidiophore, pale brown, ovoid, broadly-ellipsoid or oblong-ellipsoid, subtruncate at the apex and at the base, straight or slightly curved, smooth-walled, with 1-2 transverse septa, and 0-1 longitudinal septum, 26-54 $\times$ 16-26 μm (av. 37.5 $\times$ 21.5 μm), L/W ratio is 1.3-2.5 (av. 1.9).

The conidia of *S. plantaginis* are similar in shape to those of *S. vesicarium* (Simmons 1969), but the two species can be separated by conidia septation and wall ornamentation. The conidia in the new taxon generally have 1-2 transverse septa while those of *S. vesicarium* have 1-5 septa. In addition, the conidia of the new taxon are also smooth-walled with 0-1 longitudinal septum, as opposed to those of *S. vesicarium* that are conspicuously and densely verrucose at all ages and have 1-2 (-3) longitudinal septa.

Stemphylium capsici Yong Wang bis & X.G. Zhang, sp. nov.

FIGURE 3

Ex culturis in agar 'potato-carrot' descripta. Coloniae effusae, medio-brunneae vel brunneae. Mycelium superficiale ex hyphis ramosis, septatis, medio-brunneis, laevibus, 4.0-5.0 μm crassis compositum. Conidiophora singula, recta vel curvata, simplicia vel raro ramosa, medio-brunneae vel brunneae, cylindrica, 1-7-septata, 22-58 $\times$ 4.5-8.5 μm , ad apicem in saepissime 1 proliferationis usque 7.0-9.0 μm , inflato, laevis. Conidia singula in apice conidiophori et in proliferationis cujusque successivae oriunda, medio-brunneae vel brunneae, ovoidea, oblonga-ellipsoidea, ad apice rotundata vel subtruncata, ad basim subtruncata, recta vel curvata, 1-3 transverse septata, 0-2 longitudinaliter vel 2-5-oblique septata, distincte constricta ad septa transversa, 14-33 $\times$ 9.0-10.5 μm , laevia.

Holotype: on leaves of *Capsicum annuum* L., Arboretum of Dali, Yunnan Province, China. Aug. 5. 2002, X.G. Zhang, HSAUP III₀ 1012

Etymology: in reference to the host, *Capsicum annuum*

Colonies on PCA spreading flatly, medium brown to brown. Mycelium superficial, composed of branched, septate, medium brown, smooth, hyphae 4.0-5.0 μm wide. Conidiophores simple or occasionally branched, straight or curved, medium brown to brown, cylindrical except at the apical proliferations which are swollen or distinctly flared, 1-7-septate, 22-58 $\times$ 4.5-8.5 μm , flared apically up to 7.0-9.0 μm , smooth. Conidia developing singly through a wide pore at the apex of each conidiophore, medium brown to brown, ovoid or oblong-ellipsoid, rounded or subtruncate at the apex, and subtruncate at the base, straight or slightly curved, smooth-walled, with 1-3 transverse septa, and 0-2 longitudinal or 2-5 oblique septa, 14-33 $\times$ 7.5-12.5 μm (av. 20.0 $\times$ 11.5 μm), L/W ratio is 1.3-2.5 (av. 1.9).

The new species differs from *S. allii-cepae* and *S. lactucae* (Zhang & Zhang 2003) in the smaller size range of its conidia (14-33 $\times$ 7.5-12.5 μm). In addition, the mature conidia



Fig. 3 Conidia and conidiophores of *S. capsici*

of *S. allii-cepae* and *S. lactucae* have 1-3 and 1 distinctly constricted transverse septa respectively, while conidia of the new taxon are not distinctly constricted transverse septa. On the other hand, the conidia of the new taxon have 2-5 oblique septa, more than either *S. allii-cepae* or *S. lactucae*. The apical conidium cell of the new taxon is also less acute than that of both well-known species.

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Caribbean heterobasidiomycetes: 2. Jamaica

PETER ROBERTS

p.roberts@rbgkew.org.uk

Mycology Section, Royal Botanic Gardens

Kew, Surrey TW9 3AB, UK

Abstract – Fifty-five species of heterobasidioid fungi belonging to the orders *Atractiellales*, *Auriculariales*, *Ceratobasidiales*, *Dacrymycetales*, *Exidiales*, *Platyglloeales*, *Septobasidiales*, *Tremellales*, and *Tulasnellales* are described or reported from Jamaica. The new species *Exidia aeruginosa* and *Achroomyces dennisii* are described and the new combination *Exidiopsis scutelliformis* proposed, with *E. fuliginea* as a synonym. *Heterochaete verruculosa* sensu Bodman (et auct. seq.) is considered a mix of *H. verruculosa* sensu stricto and *Exidia japonica*. Twenty-six of the 55 species (47%) are newly recorded from Jamaica; 19 of them (34%) are also new records for the Caribbean islands.

Key words – cloud forest, endoparasites, *Basidiomycetes*, *Urediniomycetes*

The majority of species recorded in this paper were collected by the author and colleagues in June 1999 as part of the US National Science Foundation, Biotic Surveys and Inventories Program for the Greater Antilles.

The sites surveyed were almost all within the Holywell Park area of the Blue Mountains at an altitude of around 1000 m. The park is in the county of Surrey, mostly in St Andrew parish, but with one trail (Oatley Mountain) extending into Portland parish. Vegetation is mainly secondary cloud forest, with a mix of deciduous trees, *Podocarpus*, and a few planted *Pinus caribaea*. The nearby gardens at Cinchona (c. 1000 m) and upland valley woodland at Clydesdale (c. 800 m), both with some planted *Eucalyptus*, were also visited. Most of the heterobasidiomycete collections are held in the mycological herbarium [K(M)] of the Royal Botanic Gardens, Kew, but some additional collections, forwarded by Dr Karen Nakasone, are held at the Center for Forest Mycology Research (CFMR), Wisconsin, USA. Duplicate specimens are deposited in the herbarium of the Institute of Jamaica (IJ).

Previous collections from Jamaica held at Kew are also recorded. These include specimens of *Septobasidium* species from the Blue Mountains collected in 1926 by J.N. Couch (Professor of Botany at the University of North Carolina), specimens from the American botanist and collector Charles Orcutt (who moved to Jamaica in the 1920s), material sent to Kew by E.B. Martyn (plant pathologist in Jamaica from 1940 - 1950), and specimens collected by R.W.G. Dennis (Royal Botanic Gardens, Kew) in 1949–50. Also included are references to Jamaican heterobasidiomycetes in other publications, notably

the paper on Jamaican *Septobasidiales* by Couch (1929), the booklet on neotropical heterobasidiomycetes by Lowy (1971), and the checklist of Caribbean fungi by Minter et al. (2001).

A previous paper on Caribbean heterobasidiomycetes (Roberts 2003b) dealt with species from the Dominican Republic.

Atractiellales

Hobsonia mirabilis (Peck) Linder, Ann. Missouri Bot. Gard. 16: 340 (1929)

SPECIMENS EXAMINED - SURREY: St Andrew: CASTLETON BOTANICAL GARDENS, on dead palm leaf, 16 Dec. 1949, Dennis 250B, *K(M)* 85760; HOLYWELL PARK (PATH TO CABINS), on dead *Hedychium coronarium* stems, 10 June 1999, Roberts GA541, *K(M)* 63247; MORCE'S GAP, on dead *H. coronarium* stems, 25 Dec. 1949, Dennis 250C, *K(M)* 85759.

Hobsonia mirabilis produces viscid-gelatinous, hyaline to whitish fruitbodies on a variety of woody or herbaceous substrata. It has long been classed as an anamorphic ascomycete, but recent molecular research (Sikaroodi et al. 2001) has suggested that *Hobsonia* is related to the genus *Helicogloea*. The species was illustrated from Venezuela by Roberts (2003a) and recorded from the Dominican Republic by Roberts (2003b). It has not previously been reported from Jamaica.

Auriculariales

Auricularia cornea Ehrenb., in Nees von Esenbeck, Horae Phys. Berol.: 91 (1820)

Auricularia polytricha (Mont.) Sacc., in Berlese & Saccardo, Atti. R. Inst. Veneto VI. 3: 722 (1885)

SPECIMENS EXAMINED - SURREY: Portland: HOG HOLE TO CART FALLS VIEW, on dead trunk, 22 Dec. 1973, B.D. Morley & C. Whitefoord 772 (as *A. polytricha*), *K(M)* 61992; HOLYWELL PARK, OATLEY MOUNTAIN TRAIL, on log, 10 June 1999, Roberts GA561, *K(M)* 63248; NANNY TOWN, on wood, 22 Dec. 1973, B.D. Morley & C. Whitefoord 716 (as *A. polytricha*), *K(M)* 61991; PORT ANTONIO (8 MI FROM), WINNIFRED GUEST HOUSE, on log, 16 Mar. 1946, A.M. Barry F54, *K(M)* 61990; **St Andrew:** CLYDESDALE, on wood, 16 June 1999, D.J. Lodge (Roberts GA717), *K(M)* 63295; KINGSTON, on wood, June 1999, comm. Roberts, *K(M)* 121795; **St Thomas:** ARNTULLY, Apr. 1928, Orcutt 5595 (as *A. auricula*), *K(M)* 85308.

Auricularia cornea is a common and conspicuous pantropical species, distinguished by its smooth hymenium and hirsute, but unzoned pileus. The species was recorded from the Dominican Republic by Roberts (2003b) and has previously been reported from Jamaica (parishes of Manchester, Portland, St Andrew, St Ann, St Thomas, and Trelawny) in Minter et al. (2001).

Auricularia delicata (Fr.) Henn., in Bresadola et al., Bot. Jahrb. Syst. 17: 492 (1893)

SPECIMEN EXAMINED - JAMAICA. Unlocalized, Mr Poore (as *Tremella auricula*; det. M.J. Berkeley as *Exidia fuscusuccinea*), *K(M)* 51755.

Auricularia delicata is a common pantropical species characterized by its distinctly reticulate hymenium. The species was recorded from the Dominican Republic by

Roberts (2003b) and has previously been reported from Jamaica (Portland, St Andrew, St Catherine, St Elizabeth, St Thomas, and Westmorland) in Minter et al. (2001).

***Auricularia fuscossuccinea* (Mont.) Henn., Bot. Jahrb. Syst. 17: 19 (1893)**

SPECIMENS EXAMINED - JAMAICA. Unlocalized, on tree, 1928, Orcutt 4231 (as *A. tenuis*), *K(M)* 44591; **SURREY: Portland:** CORN PUSS GAP (BETWEEN PORTLAND AND ST THOMAS), on wood, 21 Feb. 1946, C.B. Lewis *F44*, *K(M)* 51767.

Auricularia fuscossuccinea is a common tropical species, distinguished by its smooth, purplish brown basidiomes, without a macroscopically hirsute pileus. The species was recorded from the Dominican Republic by Roberts (2003b) and previously reported from Jamaica (Portland, St Andrew, and St Catherine) by Lowy (1971).

***Auricularia mesenterica* (Dicks.) Pers., Myc. Eur. 1: 97 (1822)**

Auricularia mesenterica is a cosmopolitan species, distinguished by its effuso-reflexed basidiomes, with distinctly zoned and hirsute pilei and smooth to reticulate hymenia. The species was reported from Jamaica (Manchester, St Andrew, and Trelawny) by Lowy (1971).

Ceratobasidiales

***Ceratobasidium noxium* (Donk) P. Roberts, Rhizoctonia-forming fungi: 48 (1999)**

Koleroga noxia Donk, Fungus 28: 35 (1958)

Pellicularia koleroga Cooke, Grevillea 4: 116 (1876), p.p. [nom. conf.]

SPECIMENS EXAMINED - JAMAICA. Unlocalized, on living *Citrus maxima* leaves, July 1948, Martyn *P/P* 340, *K(M)* 52849; **MIDDLESEX: Manchester:** NEAR MANDEVILLE, on living *Coffea* leaf, Oct. 1892, anon. (as *Pellicularia koleroga*), *K(M)* 29392; **St Catherine:** LINSTEAD, on living *Mangifera indica* leaves, 27 Sep. 1967, F. Thompson *CB* 1120, *K(M)* 52933.

Ceratobasidium noxium is a widespread tropical species, originally described from India, but with few recent records. It forms web-blights on living leaves of trees and shrubs, causing the disease variously called 'black rot', 'koleroga', or 'candelillo' in coffee. The species was previously reported from Jamaica in Minter et al. (2001) as *Pellicularia koleroga*, a nomen confusum. *Ceratobasidium noxium* was redescribed and illustrated in Roberts (1999).

***Thanatephorus cucumeris* (A.B. Frank) Donk, Reinwardtia 3: 376 (1956)**

[anamorph] *Rhizoctonia solani* J.G. Kühn, in Die Krankheiten der Kulturgewächse: 224 (1858)

Thanatephorus cucumeris, mostly found in its anamorphic (mycelial) state, is a cosmopolitan plant pathogen on an extremely wide range of hosts. It was reported in Minter et al. (2001) from the parishes of St Andrew, St Catherine, and St Thomas in Jamaica, and was previously recorded from the Dominican Republic by Roberts (2003b). The species was redescribed and illustrated, with synonyms listed, in Roberts (1999).

Dacrymycetales

Calocera cornea (Batsch) Fr., Stirp. Agri. Fems. 5: 67 (1827)

Originally described from Germany, *Calocera cornea* is a cosmopolitan species distinguished by its gregarious, yellowish, subulate-cylindrical, gelatinous basidiomes up to 10 mm high, its unclamped hyphae, and its comparatively small, single-septate basidiospores. It was reported by Lowy (1971) from St Andrew and St Thomas parishes.

Cerinomyces crustulinus (Bourdot & Galzin) G.W. Martin, Mycologia 41: 85 (1949)

Fig. 1

Basidiomes discoid at first, c. 1 mm across, then coalescing and becoming smooth, effused, gelatinous, 20 mm or more across, translucent tawny when fresh, drying similar. The whitish, fimbriate subiculum is visible at margins.

Hyphae hyaline, 4 - 6 μm wide in context, walls thickly gelatinized in KOH, with clamp-connexions; hyphidia conspicuous, branched; basidia dacrymycetoid, c. 30 μm long; basidiospores cylindrical ($Q = 3.0 - 3.7$), 14 - 15.5 x 3.5 - 5 μm , allantoid, aseptate.

SPECIMEN EXAMINED - SURREY: St Andrew: HOLYWELL PARK, FAIRY GLADE TRAIL, on wood, 13 June 1999, Roberts GA649, K(M) 116646.

Following McNabb (1964) and subsequent authors, this effused species accords quite well with *Cerinomyces crustulinus* as originally described from France and recorded from North America. The presence of branched hyphidia is a distinguishing feature of the species. The Jamaican collection differs, if at all, from McNabb's description in having larger spores (McNabb gave 9 - 11 (- 12) x 3 - 4 μm as the spore measurement) and context hyphae with gelatinized walls. *Cerinomyces crustulinus* has not previously been recorded from the Caribbean.

Dacrymyces capitatus Schwein., Trans. Am. Phil. Soc. II, 4: 186 (1832)

SPECIMEN EXAMINED - SURREY: St Andrew: HOLYWELL PARK, WATERFALL TRAIL, on wood, 8 June 1999, K. Nakasone (Roberts GA521), K(M) 98265.

The Jamaican collection falls within a rather difficult group of unclamped *Dacrymyces* species with 1-3-septate basidiospores. It is distinguished mainly by its distinctly discoid basidiomes attached to the substratum at a point. The species was originally described from North America and is cosmopolitan, though not previously recorded from the Caribbean.

Dacrymyces chrysospermus Berk. & M.A. Curtis, in Berkeley, Grevillea 2: 20 (1873)

SPECIMEN EXAMINED - SURREY: St Andrew: CLYDESDALE, on decorticated log, 16 June 1999, Roberts GA716, K(M) 98264.

Dacrymyces chrysospermus is distinguished by its coalescing, cerebriform basidiomes, its unclamped hyphae, and its 7-septate basidiospores. The species was originally described from North America and appears to be cosmopolitan. It has not, however, previously been reported from the Caribbean.

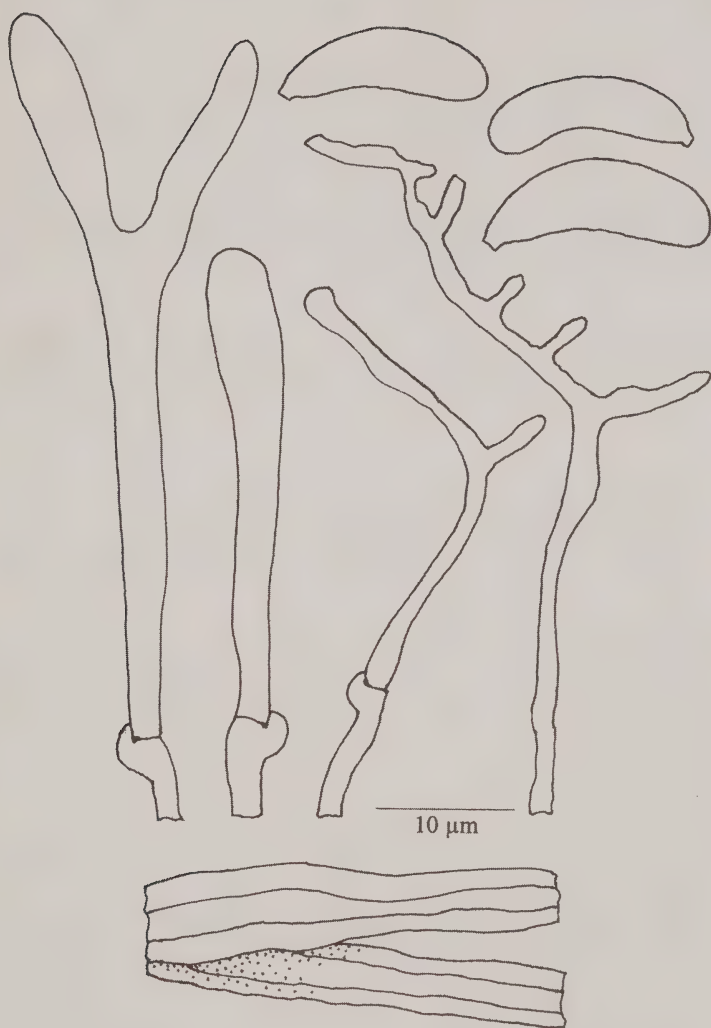


Fig. 1. *Cerinomyces crustulinus* (Jamaica, K(M) 116646). Mature and immature basidia with basal clamp-connexions; aseptate basidiospores; branched hyphidia; thick-walled context hyphae.

Dacrymyces falcatus Brasf., Lloydia 1: 154 (1938)

Originally described from Panama, the species is distinguished by its clampless hyphae and basidiospores with 15 or more septa. It was reported by Lowy (1971) for Portland parish.

Dacrymyces minor Peck, Rep. New York Mus. Nat. Hist. 30: 49 (1878)

SPECIMEN EXAMINED - SURREY: **St Andrew:** HOLYWELL PARK, WATERFALL TRAIL, on fallen decorticated stick, 14 June 1999, Roberts GA668, *K(M)* 98261.

The collection comprises a swarm of small, discoid, dull orange basidiomes having unclamped hyphae and 1 – 3-septate basidiospores, the septa slightly thickened. As such, it seems best referred to *Dacrymyces minor*, originally described from North America and reported from the Dominican Republic by Roberts (2003b). The species has not previously been recorded from Jamaica.

Dacryopinax elegans (Berk. & M.A. Curtis) G.W. Martin, Lloydia 11: 116 (1948)

Dacryopinax elegans is a spatulate species with 3-septate basidiospores, originally described from the southern United States. It was reported by Lowy (1971) for Clarendon parish.

Dacryopinax spathularia (Schwein.) G.W. Martin, Lloydia 11: 116 (1948)

SPECIMENS EXAMINED - MIDDLESEX: **St Mary:** ORANGE RIVER EXPERIMENTAL STATION, Jan. 1948, Martyn *P/P* 290, *K(M)* 52664; SURREY: **St Andrew:** CLYDESDALE, on fallen wood, 16 June 1999, D.J. Lodge (Roberts GA718), *K(M)* 114754; **St Thomas:** BATH, on wooden gate, Mar. 1946, A.M. Barry *F36*, *K(M)* 52663.

This is a ubiquitous warm temperate and tropical species, producing conspicuous, spatulate basidiomes. It was originally described from North America and has previously been reported from the parishes of Portland, St Andrew, and St Thomas in Minter et al. (2001). It was reported from the Dominican Republic in Roberts (2003b).

Guepiniopsis buccina (Pers.) L.L. Kenn., Mycologia 50: 888 (1958)

SPECIMENS EXAMINED - SURREY: **St Andrew:** MORCE'S GAP, on wood, 10 June 1888, W. Fawcett (as *Guepinia pezizaeformis*), *K(M)* 8698; **St Helen:** GAP TO MONKEY HILL, on wood, 1 Sep. 1957, A.L. Welden 878, *K(M)* 8699.

Guepiniopsis buccina is a cosmopolitan species producing trumpet-like basidiomes (cup-shaped with a long stipe). The collections cited above were previously reported by McNabb (1965).

Exidiales

Basidiodendron cinereum (Bres.) Luck-Allen, Can. J. Bot. 41: 1043 (1963)

SPECIMENS EXAMINED - SURREY: **St Andrew:** HOLYWELL PARK, WAG WATER RIVER TRAIL, on dead *Hedychium coronarium* stem, 11 June 1999, Roberts GA600, *K(M)* 63274; same location and date, on *Pinus caribaea* stick, Roberts GA610, *K(M)* 114690;

HOLYWELL PARK, WATERFALL TRAIL, on fallen wood, 14 June 1999, Roberts GA675, K(M) 63320.

Basidiodendron cinereum is a cosmopolitan species or species complex, originally described from Italy. Like all *Basidiodendron* species, the basidiomes are normally thin, effused, greyish and farinaceous-ceraceous, often drying ochraceous and finely reticulate. The specimen K(M) 63274 is typical, having a thin farinaceous basidiome with abundant gloecystidia under the microscope and basidiospores measuring $9.5 - 11 \times 5.5 - 7 \mu\text{m}$. The specimens K(M) 63274 and K(M) 114690 are microscopically similar, but have thicker, ceraceous basidiomes, possibly representing more mature specimens.

An additional collection (SURREY: St Andrew: HOLYWELL PARK, WATERFALL TRAIL, on twig, 14 June 1999, Roberts GA689, K(M) 116886) has a thin, pale greyish, farinaceous basidiome and appears similar to a *Basidiodendron* species, but lacks gloecystidia. The basidiospores are close to those of *B. cinereum*, measuring $11.5 - 13.5 \times 6.5 - 7.5 \mu\text{m}$. The specimen is tentatively referred to *B. cinereum*, but may well represent a distinct species.

Basidiodendron cinereum has not previously been reported from the Caribbean.

Basidiodendron eyrei (Wakef.) Luck-Allen, Can. J. Bot. 41: 1034 (1963)

SPECIMENS EXAMINED - SURREY: St Andrew: HOLYWELL PARK, FAIRY GLADE TRAIL, on fallen wood, 13 June 1999, Roberts GA652, K(M) 63324; same location, on hardwood twigs, 15 June 1999, Nakasone 150383, CFMR; HOLYWELL PARK, WATERFALL TRAIL, on dead tree fern stems, 8 June 1999, Roberts GA505, K(M) 63398; same location, on fallen wood, 14 June 1999, Roberts GA664, K(M) 63319.

Basidiodendron eyrei is a common, cosmopolitan species, originally described from England. It is distinguished by its comparatively small subglobose to globose basidiospores (with Q frequently <1.0 , hence with the apiculus on one of the wider sides) and the formation of conspicuous 'acropetal basidial stalks' in mature specimens. Basidiospores are typically $3.5 - 5 \mu\text{m}$ across, but in some of the collections cited above they are slightly larger, up to $5.5 - 6 \mu\text{m}$ across. The species has not previously been reported from Jamaica.

Basidiodendron fulvum (Masse) Ginns, Opera Botanica 61: 54 (1982)

SPECIMENS EXAMINED - SURREY: St Andrew: HOLYWELL PARK, OATLEY MOUNTAIN TRAIL, on fallen wood, 15 June 1999, Roberts GA694, K(M) 63321; CINCHONA, TRAIL TO MORCE'S GAP, on decayed hardwood, 12 June 1999, Nakasone 150309, CFMR and K(M) 116728; USA. NEW JERSEY, NEWFIELD, on *Magnolia* sp., undated, J.B. Ellis 3399, HOLOTYPE, K(M) 28713.

Basidiodendron fulvum, described from the USA (type cited above), is similar to *B. eyrei* but is distinguished by its smaller basidia and basidiospores. It was recorded from Venezuela in Roberts (2003a), but has not previously been reported from the Caribbean.

Basidiodendron radians (Rick) P. Roberts, Kew Bull. 56: 170 (2001)

Basidiodendron nodosum Luck-Allen, Can. J. Bot. 41: 1045 (1963)

SPECIMENS EXAMINED – BRAZIL. RIO GRANDE DO SUL: SÃO LEOPOLDO, on wood, 1930, J. Rick 47, **HOLOTYPE**, K(M) 56863; CANADA. ONTARIO: Algoma Dist.: LITTLE WHITE RIVER, on decayed *Pinus* wood, 14 Sep. 1956, R.F. Cain, **HOLOTYPE** of *Basidiodendron nodosum*, TRTC 33408; JAMAICA. SURREY: Portland: HOLYWELL PARK, OATLEY MOUNTAIN TRAIL, on rotten fallen wood, 10 June 1999, Roberts GA574, K(M) 116642; St Andrew: CINCHONA, on rotten *Podocarpus* wood, 9 June 1999, Roberts GA538, K(M) 113669; HOLYWELL PARK, FAIRY GLADE TRAIL, on decorticated hardwood, 15 June 1999, Nakasone 150380, CFMR.

Basidiodendron radians is similar to *B. cinereum* (above), but differs in its subglobose to ellipsoid basidiospores ($Q = 1.1 - 1.4$). The species was originally described from Brazil (the synonym *B. nodosum* from Canada) but appears to be cosmopolitan. Type specimens have been examined and are cited above. It was redescribed and illustrated from the Balearic Islands by Roberts (1996, as *B. nodosum*). Though apparently common, the species has not previously been reported from the Caribbean.

The specimen K(M) 116642 is extremely thin and unusual in having swollen elements, some with yellowish contents, which are branched and appear intermediate between hyphidia and gloeocystidia.

Basidiodendron spinosum (L.S. Olive) Wojewoda, Mała Flora Grzybów II: 91 (1981)

SPECIMEN EXAMINED - SURREY: St Andrew: HOLYWELL PARK, WATERFALL TRAIL, on fallen wood, 8 June 1999, Roberts GA513, K(M) 63259.

Basidiodendron spinosum is a cosmopolitan species, recognized microscopically by its distinctly warted basidiospores. It was originally described from Tahiti and has been redescribed and illustrated from Costa Rica by Kisimova-Horovitz et al. (1997) and noted from Venezuela by Roberts (2003a). It has not previously been reported from the Caribbean.

Ductifera sucina (Möller) K. Wells, Mycologia 50: 413 (1958)

Originally described from Brazil, *Ductifera sucina* was redescribed and reported from Jamaica by Wells (1957) and Lowy (1971), based on a collection from Morce's Gap (St Andrew). The species forms pallid, pustular to cerebriform basidiomes with gloeocystidia.

Eichleriella alliciens (Berk. & Cooke) Burt, Ann. Missouri Bot. Gard. 2: 746 (1915)

Exidiopsis alliciens (Berk. & Cooke) K. Wells, Mycologia 53: 354 (1962 ['1961'])

Originally described from Brazil, *Eichleriella alliciens* was reported from Jamaica by Wells (1961, as *Exidiopsis alliciens*). The species forms ochraceous, effused, stereoid basidiomes and appears to be cosmopolitan.

Eichleriella leveilleanum (Berk. & M.A. Curtis) Burt, Ann. Missouri Bot. Gard. 2: 744 (1915)

Originally described from the United States, *Eichleriella leveilleanum* was reported from Jamaica by Wells (1961). The species forms reddish, effused, stereoid basidiomes and appears to be restricted to the Americas.

Exidia aeruginosa P. Roberts sp. nov.

Fig. 2

Basidiomata gelatinosa, pustulata vel lobata, stipitata, usque ad 10 mm lata, areolata, non setulosa, grisea vel brunnea, subter aeruginosa; hyphae 1 - 2.5 µm latae, fibulatae; hyphidia ramosa; basidia tremelloidea, quadricellularia, oblonga, 23 - 25 x 12 - 13 µm; basidiosporae cylindraceae, suballantoideae, 16 - 22 x 7.5 - 9.5 µm.

Holotype: JAMAICA. SURREY: St Andrew: HOLYWELL PARK, WATERFALL TRAIL, on dead attached deciduous twigs, 14 June 1999, Roberts GA670, K(M) 116842.

Basidiomes small, gelatinous, pustular to lobate, stipitate, up to 10 mm across, strongly areolate and appearing (overall) dull grey to brown in the field. Under lens, areolate to reticulate with distinct, rather roughened ridges, hymenial surface between ridges smooth (without hyphal pegs), brown to rusty brown at surface, bluish green below. When dried, pustular, dark greyish brown.

Hymenium comprising a surface layer of basidia and hyphidia in a brown gelatinous matrix, arising from a loosely gelatinized (not agglutinated), bluish-green context; **hyphae** hyaline, narrow, 1 - 2.5 µm wide, highly branched and irregular, thin-walled, with conspicuous clamp-connexions; **hyphidia** finely branched; **cystidia** absent; **basidia** tremelloid, 4-celled, oblong ($Q = 1.7 - 1.9$), 23 - 25 x 12 - 13 µm, immature basidia narrow and often fusiform; **sterigmata** elongated and sinuous; **basidiospores** (not clearly seen) apparently cylindrical ($Q = 2.0 - 2.5$), weakly allantoid, 16 - 22 x 7.5 - 9.5 µm.

Exidia aeruginosa is distinguished by its unusual bluish green basidiomes with a rusty to brownish hymenial layer. This striking colouration is not only visible under a lens, but microscopically when mounts are made in water, the brownish gelatinized matrix of the hymenium contrasting with the equally gelatinized blue-green context. In addition, the species is unusual in having a smooth but alveolate hymenium, lacking hyphal pegs. Microscopically, the hyphae are exceptionally narrow and the basidia comparatively large (often fusiform when young). Despite the presence of abundant mature basidia, very few basidiospores were seen and their true range and size remains uncertain.

The keys to Caribbean and Latin American *Exidia* species published by Lowy (1971, 1980) suggest no close match to this species, all but one of the taxa treated being 'papillate' (i.e. with hyphal pegs). Nonetheless, the type and only collection of *Exidia antiquae* Lowy (GUATEMALA. FINCA SAN MAYOR, on fallen *Quercus* branches, 25 June 1963, Lowy G216, LSUM) was re-examined, since it was described as having 'distinctly greenish tints when fresh'. From this re-examination, it appears that *Exidia antiquae* differs from *E. aeruginosa* not only in having hyphal pegs on the hymenial surface, but also in its much smaller basidia (13 - 17 x 8 - 9 µm) and basidiospores (9.5 - 13 x 4.5 - 5 µm). The greenish tints are no longer apparent in the type collection and may have been algal in origin, since superficial algal cells are present in mounts. Morphologically *Exidia*

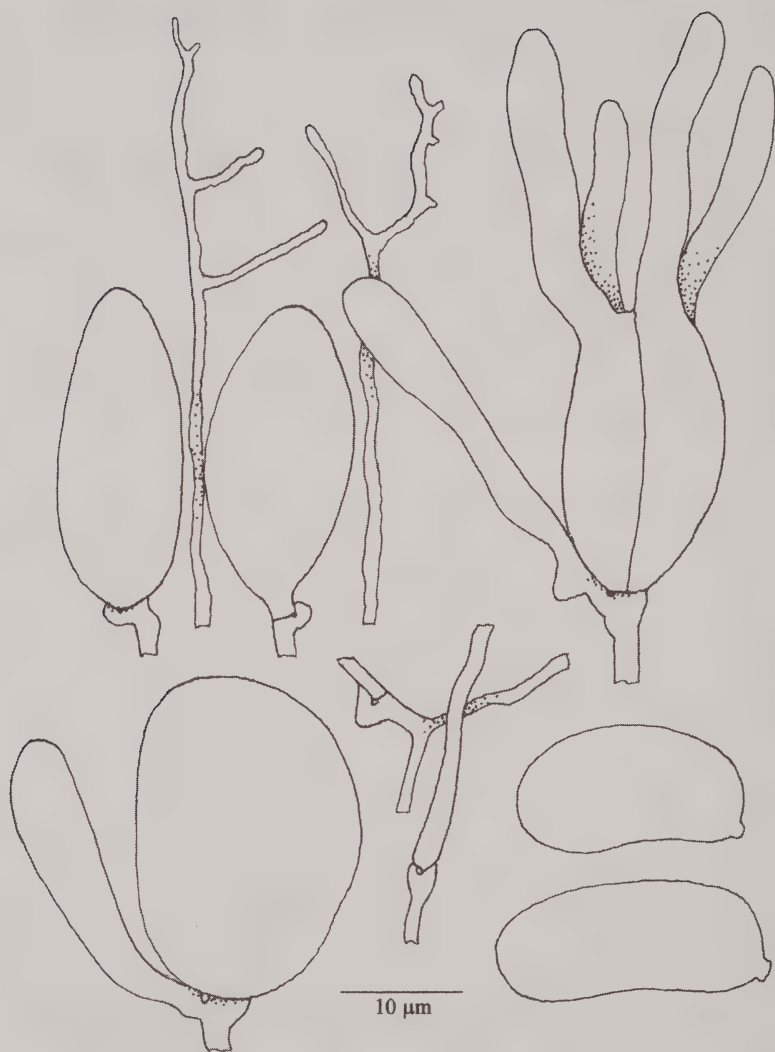


Fig. 2. *Exidia aeruginosa* (Jamaica, holotype, K(M) 116842). Immature and mature basidia, with branched hyphidia; clamped hyphae; basidiospores.

antiguae appears close to and possibly conspecific with *E. plana* (F.H. Wigg.) Donk sensu Donk (1966).

A second possible species, not treated by Lowy (1971, 1980), is *Exidia alveolata* Pat., which was said to be alveolate (like *E. aeruginosa*), pale smoky-brown, and smooth. However a re-examination of the type and only collection (ECUADOR. COTACOLLAO, on dead wood, Feb. 1892, Lagerheim, FH) showed that *E. alveolata* differs from *E. aeruginosa* in having sparse but distinct hyphal pegs on the hymenial surface (not mentioned in the type description), as well as in its smaller basidia (14 - 17 x 10 - 12.5 µm) and basidiospores (10.5 - 16 x 4 - 6 µm).

Exidia japonica Lloyd, Mycol. Not. 5: 599 (1916)

SPECIMENS EXAMINED – COLOMBIA. Magdalena: SIERRA NEVADA DE SANTA MARTA, HACIENDA CINCEMATI, on palm, 22 Aug. 1935, G.W. Martin 3626, (as *Heterochaete verruculosa*) IA 398729; JAMAICA. SURREY: St Andrew: HERMITAGE RESERVOIR, on bark of decaying log, 30 May 1954, R.P. Bengry F1024 (as *Exidia* sp.), K(M) 44819; HOLYWELL PARK, SHELTER TRAIL, on branch, 17 June 1999, Roberts GA729, K(M) 116889; PANAMA. CHIRIQUI, VALLEY OF UPPER RIO CHIRIQUI VIEJO, on wood, 4 July 1935, G.W. Martin 2502, (as *H. verruculosa*) IA 379886.

The more recent Jamaican collection (Roberts GA729) comprises several small, shallowly pustulate basidiomes which are partly coalesced and lobate to effused. Rehydrated, they are watery greyish, highly gelatinous, and covered in small but easily visible, whitish hyphal pegs, 60 - 75 µm high. The basidiomes are immature, but developing basidia are present, as are brown, gloeoplerous hyphidia (contrasting with the hyaline hyphae and context), and clusters of mineral matter, particularly in the pegs. The earlier collection (Bengry F1024) looks similar but is extensively effused, highly gelatinized, 'greyish-white, somewhat convolute' (according to accompanying notes), the pegs with clustered mineral matter and the basidiospores measuring 9.5 - 12 x 4 - 4.5 µm.

These features agree well with the redescription and illustration of *Exidia japonica* in Spooner & Roberts (1998), based on collections from Brunei and Australasia, and further redescriptions based on material from Cameroon (Roberts 2001) and Venezuela (Roberts 2003a). *Exidia japonica* has not previously been recorded from the Caribbean.

Heterochaete verruculosa (Möller) Bodman, originally described from Brazil, was said to have very thin, effused, gelatinized, whitish basidiomes with small hyphal pegs (up to 70 µm high), small basidia, and basidiospores measuring 9 - 10 x 4 µm (Möller 1895). The type no longer survives, but recent material matching this description (BRAZIL. SÃO PAULO: Cananeia Mun.: ILHA CARDOSO, on branch, 5 Feb. 1987, K. Hjortstam 16819, K(M) 116892) has been examined. The species has some features in common with *Exidia japonica* (e.g. spore size, size of hyphal pegs, gelatinized context), but differs inter alia in being entirely effused, closely attached, and very thin (tissue-paper thin, according to Möller).

As re-interpreted by Bodman (1952), however, '*Heterochaete verruculosa*' appears to be a mix of Möller's original species description and *Exidia japonica*. A specimen from Colombia, examined by Bodman and cited above, consists of discrete, shallowly pustular patches together with larger, thickly gelatinous, effused areas. Basidia are c. 11-12

x 7 - 8 μm , the basidiospores 8 - 10 x 3.5 - 4.5 μm , the hyphidia mainly collapsed but gloeoplerous. A second specimen from Panama, also examined by Bodman and cited above, is effused but thickly gelatinous and has similar microscopic features, including brown gloeoplerous hyphidia. Both collections seem better referred to *Exidia japonica*.

Exidia nucleata (Schwein.) Burt, Ann. Missouri Bot. Gard. 8: 371 (1921)

Tremella nucleata Schwein., Naturf. Ges. Leipzig Schr. 1: 115 (1822)

Myxarium nucleatum Wallr., Flora Crypt. Germaniae: 26 (1833)

SPECIMEN EXAMINED - JAMAICA. SURREY: St Andrew. HOLYWELL PARK, SHELTER TRAIL, on fallen twigs, 17 June 1999, Roberts GA724, K(M) 63346.

Originally described from the United States, this is a cosmopolitan species recognized inter alia by its pustulate, hyaline basidiomes, conspicuous mineral inclusions, and myxarioid (stalked) basidia. The species was extensively redescribed and illustrated by Reid (1970) as *Myxarium nucleatum*. It has not previously been recorded from Jamaica.

Exidiopsis galzinii (Bres.) Killerm., in Engler & Prantl, Die natürlichen Pflanzenfamilien (2nd ed.) 6: 113 (1928)

Bourdotia petiolata (D.P. Rogers) K. Wells, Lloydia 20: 54 (1957)

This effused species with conspicuous gloeocystidia was reported from Jamaica by Wells (1959, as *Bourdotia petiolata*). It was redescribed and illustrated from the Dominican Republic by Roberts (2003b).

Exidiopsis scutelliformis (Berk. & M.A. Curtis) P. Roberts **comb. nov.**

Fig. 3

Hirneola scutelliformis Berk. & M.A. Curtis, in Berkeley, Grevillea 2: 19 (1873)

Exidiopsis fuliginea Rick, Broteria 5: 8 (1906)

Basidiomes effused, margins indistinct, smooth, ceraceous to subgelatinous, hyaline to pale brown, drying to a thin, grey, vernicose film.

Hymenium comprising a layer of clustered basidia, cystidia, and hyphidia arising from a loosely gelatinized (not agglutinated) context intermixed with amorphous accretions of mineral matter; **hyphae** hyaline, 1.5 - 2.5 μm wide, thin-walled, with clamp-connexions; **hyphidia** nodulose to branched, often with dark brown granular contents contrasting against the hyaline context and hyphae. Narrow, disconnected lines of granules form a loose network at the hymenial surface; **cystidia** frequent in the hymenium, hyaline, thin-walled, most clavate to fusiform, 25 - 40 x 8 - 10 μm , but many irregular; **basidia** tremelloid, 4-celled, globose to subglobose ($Q = 1.0 - 1.2$), 10 - 12 x 9 - 10 μm , typically in clusters; **sterigmata** four, becoming sinuous and elongated; **basidiospores** cylindrical ($Q = 3.0 - 3.3$), 12 - 13.5 x 4 - 4.5 μm , weakly allantoid.

SPECIMENS EXAMINED - BRAZIL. RIO GRANDE DO SUL: SÃO LEOPOLDO, on stick, 1905, J. Rick, **LECTOTYPE** of *Exidiopsis fuliginea*, FH; JAMAICA. SURREY: St Andrew. HOLYWELL PARK, WATERFALL TRAIL, on twig, 14 June 1999, Roberts GA667, K(M) 98281; USA. ALABAMA: unlocalized on *Asimina* branch, undated, Peters 6343 (ex herb. M.J. Berkeley), **HOLOTYPE**, K(M) 8208.

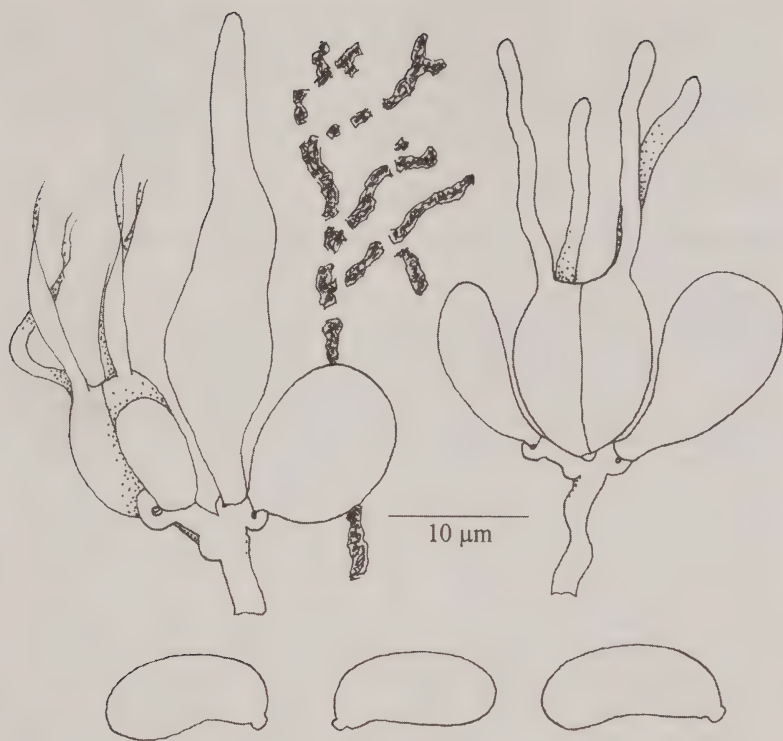


Fig. 3. *Exidiopsis scutelliformis* (Jamaica, K(M) 98281). Cystidium in cluster of old and immature basidia; granular, browning, branched hyphidium; cluster of mature and immature basidia; basidiospores.

Exidiopsis scutelliformis was originally described from Alabama 'looking like a flat *Peziza*...hymenium brown. Sometimes laterally confluent, and forming a continuous mass' (Berkeley 1873). The type specimen (cited above) consists of two pieces of bark, one showing disc-shaped fruitbodies a few millimetres across, occasionally coalescing, the other a more effused fruitbody. Microscopically they appear identical. All other specimens seen are effused. The type specimen was originally identified as '*Exidia scutelliformis*' (in pencil) with '*Hirneola*' (in ink) overwriting '*Exidia*'. An accompanying letter from De Seynes (dated 1876) notes that *Hirneola scutelliformis* is an *Exidia*, but this redistribution seems never to have been published. There are additional specimens at K from South Carolina. The species is distinguished by its normally effused, subgelatinous basidiomes, its cylindrical to subballantoid basidiospores, the clustered basidia in a loosely gelatinized context, the irregular presence of cystidia-like elements, accretions of mineral matter in the hymenium, and the granular, browning hyphidia.

Exidiopsis fuliginea appears indistinguishable from and hence synonymous with *E. scutelliformis*. The species was originally described from Brazil and was re-examined by Wells (1957) and Roberts (2001), who illustrated the type collection (cited above) and noted its occurrence in Africa. The species has been reported from the southern USA under both names (Wells 1957), but has not previously been recorded from Jamaica.

Heterochaete crassa Bodman, *Mycologia* 41: 531 (1949)

Fig. 4

Basidiomes effused, pale pinkish brown, +/- athelioid, dry (not gelatinous), with 5 - 6 erect, narrow, tubular, hyphal pegs per mm.

Hyphal system dimitic; **hyphae** (generative) collapsing and not easily seen, hyaline, c. 2 µm wide, thin-walled, with clamp-connexions; skeletal hyphae pale yellowish to ochre-brown, 2.5 - 4.5 µm wide, thick-walled. Hyphal pegs mainly composed of brown skeletal hyphae, the whole peg encrusted with amorphous clots of mineral matter; **hyphidia** not evident, but simple obtuse or subacute elements in the hymenium; **cystidia** absent; **basidia** tremelloid, 4-celled, clavate to oblong, c. 26 x 10 µm; **basidiospores** cylindrical (Q = (1.6 -) 2.0 - 2.4), (10 -), 13 - 15.5 x 6 - 6.5 µm, some ventrally depressed.

SPECIMENS EXAMINED - JAMAICA. CORNWALL: Trelawny. QUICKSTEP (COCKPIT COUNTRY), on rotten wood, 30 Dec. 1949, Dennis J132, K(M) 44824; USA. FLORIDA: Dade Co. MIAMI, SIMPSON PARK, on *Nectandra coriacea*, 17 Nov. 1942, R. Singer F1494, TYPE, FH 380016.

The description above is based on the Jamaican collection, which is notable for its dimitic hyphal system with skeletal hyphae predominating, for its narrow, clavate basidia, and for its comparatively small, cylindrical (not or barely allantoid) basidiospores.

Following Bodman (1952), the collection keys closest to *Heterochaete brasiliensis* Bodman. But re-examination of the type specimen (BRAZIL. RIO GRANDE DO SUL: SÃO SALVADOR, May 1942, J. Rick, IA 380012), shows that, though macroscopically similar, *H. brasiliensis* differs from the Jamaican material in having smaller basidia (most just 20 µm or so long) and shorter, more allantoid spores, as well as having many individually encrusted hyphae in the hyphal pegs. A more recent Brazilian collection in the Kew herbarium, closely resembling the type, has also been examined.

The North American type of *H. crassa* (cited above) has a macroscopically similar basidiome, though deeper coloured, and is very similar microscopically. Basidia (erroneously given as 'oval or globose, rarely exceeding 20 µm in length' in Bodman 1952) are clavate to oblong in the type collection, averaging 26 - 28 x 10 - 12 µm. Hyphae are similar and basidiospores are not (or barely) allantoid, c. 12 - 16 x 6 - 7 µm. This agrees well with the Jamaican collection cited above.

Heterochaete crassa is a little-known species, first described from Florida and also reported from Brazil. It is not impossible that *H. brasiliensis*, which is equally little-known, is just part of the variation within a single species, but if so *H. crassa* is the earlier name. Neither species has previously been recorded from the Caribbean.

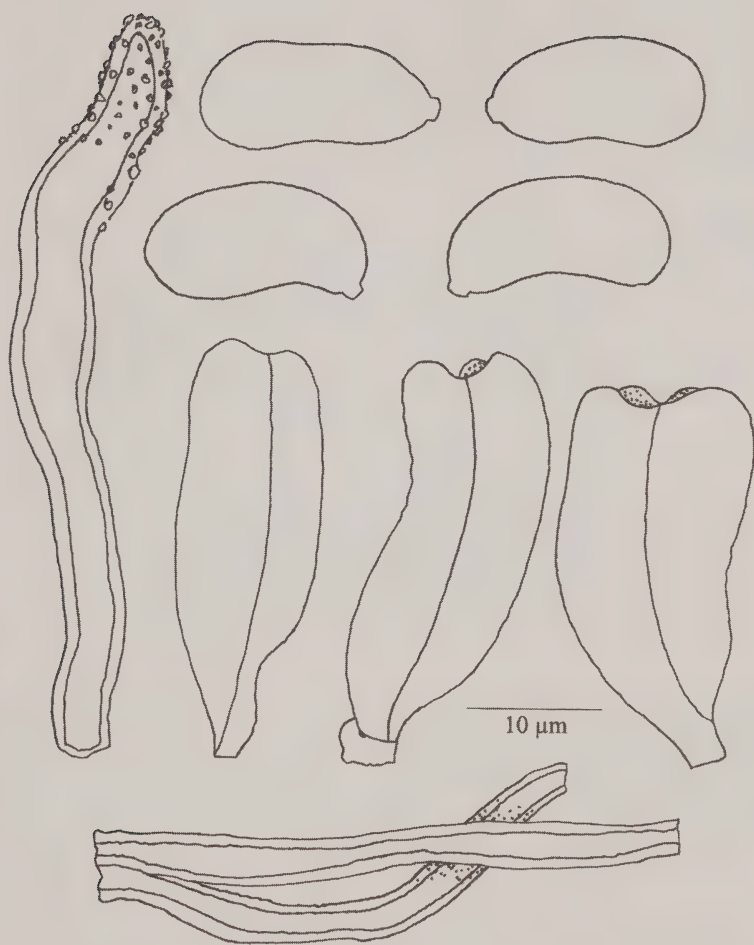


Fig. 4. *Heterochaete crassa* (USA, holotype, FH 380016). Simple, thick-walled hyphidium; basidiospores; immature basidia; thick-walled context hyphae.

Heterochaete minuta Pat., Bull. Soc. Mycol. France 9: 139 (1893)

Fig. 5

Basidiomes effused, off-white with pale brownish tints, thin, farinaceous to athelioid, dry (not gelatinous), closely attached, forming patches up to 40 x 8 mm, with c. 8 narrow, tubular, hyphal pegs per mm.

Hyphal system monomitic; hyphae hyaline, torulose, not easily seen, 1.5 – 2.5 μm wide, thin-walled, with clamp-connexions; hyphal pegs narrow, tubular, c. 200 x 40 – 50 μm ; hyphidia conspicuous, branched, coated as if iced with a mineral exudate;

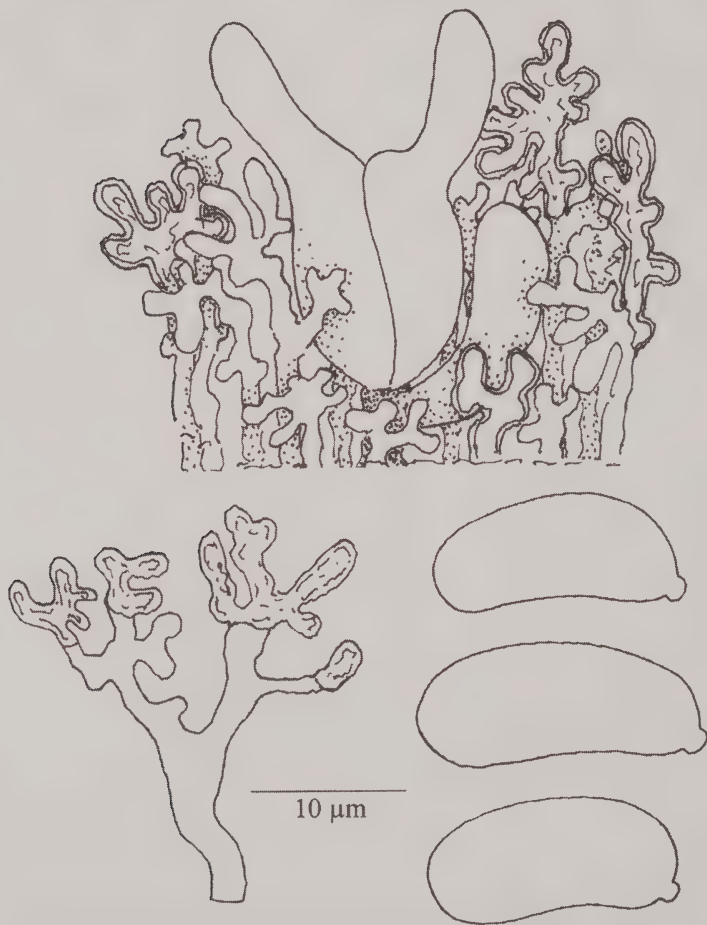


Fig. 5. *Heterochaete minuta* (Jamaica, K(M) 121868). Section from hymenium showing basidium and partly encrusted, branched hyphidia; partly encrusted, branched hyphidium; basidiospores.

cystidia absent; basidia (few seen) tremeloid, 2 - 4-celled, ellipsoid to oblong, c. 16 x 11 µm; basidiospores cylindrical ($Q = 2.2 - 2.7$), 13 - 19 x 6.5 - 7 µm, some ventrally depressed.

SPECIMENS EXAMINED – ECUADOR. PULULAHUA, on fallen twigs, Mar. 1892, G. de Lagerheim, HOLOTYPE, FH; JAMAICA. SURREY: St Andrew. HOLYWELL PARK, SHELTER TRAIL, on dead twig, 12 June 1999, Roberts GA616, K(M) 121868.

Macroscopically, *Heterochaete minuta* is distinguished by its thin, off-white basidiomes densely covered in long, narrow hyphal pegs. Microscopically, the hyphidia are distinctive, being covered by a thin, continuous layer of mineral matter (as if iced-over) and hence prominent and conspicuous.

The type specimen (cited above) consists of several small, barely visible, streak-like patches (hence presumably the epithet) which under a lens appear very similar to the Jamaican collection. Microscopically, the same prominent, coated hyphidia are evident. Patouillard & de Lagerheim (1893) gave basidiospore dimensions as 16 - 18 x 5 - 6 µm.

The species is little-known, but said by Bodman (1952) to occur in Guyana and Panama as well as Ecuador. There is also a collection at K from Colombia. It has not previously been reported from the Caribbean.

Heterochaete shearii (Burt) Burt, Ann. Missouri Bot. Gard. 8: 377 (1921)

SPECIMENS EXAMINED - JAMAICA. MIDDLESEX: St Catherine. WORTHY PARK, on *Piper* stick, 10 Feb. 1959, D.A. Powell 701, K(M) 85788; SURREY: St Andrew. HOLYWELL PARK, OATLEY MOUNTAIN TRAIL, on decorticated branch, 14 June 1999, Nakasone 150446, CFMR and K(M) 116879; HOLYWELL PARK, SHELTER TRAIL, on dead twigs, 10 June 1999, Nakasone 150299, CFMR; same location, on dead standing wood, 12 June 1999, Roberts GA630, K(M) 63323; HOLYWELL PARK, WATERFALL TRAIL, on dead branches, 13 June 1999, Nakasone 150356, CFMR.

Heterochaete shearii can be distinguished macroscopically by its effused, greyish-brown basidiomes, bruising brown, with abundant but irregular, tubular hyphal pegs, and microscopically by its brown subicular hyphae, frequent cystidia-like elements in the hymenium, and consistently bisterigmate basidia (illustrated in Roberts 2001). The species, originally described from North America, is common and widespread, but has not previously been reported from Jamaica.

Oliveonia fibrillosa (Burt) Donk, Fungus 28: 20 (1958)

SPECIMENS EXAMINED - JAMAICA. SURREY: Portland. HOLYWELL PARK, OATLEY MOUNTAIN TRAIL, on fallen wood of *Podocarpus* (?) sp., 10 June 1999, Roberts GA571, K(M) 113671; St Andrew. HOLYWELL PARK, TRAIL TO CABINS, on dead stem of *Heydichium coronarium*, 17 June 1999, Roberts GA727, K(M) 114698.

Oliveonia fibrillosa typically produces thin, effused basidiomes on dead wood or herbaceous stems. Microscopically, it is recognised by its aseparate basidia, clamped hyphae, hyaline cystidia, and ventrally depressed to suballantoid basidiopores. The species was redescribed and illustrated in Roberts (1999). It appears to be cosmopolitan, though infrequently collected. *Oliveonia fibrillosa* was originally described from Mexico

and has been reported from Venezuela (Roberts 2003a), but has not previously been recorded from the Caribbean.

Stypella dubia (Bourdot & Galzin) P. Roberts, Mycotaxon 69: 216 (1998)

SPECIMENS EXAMINED - JAMAICA. SURREY: St Andrew. CLYDESDALE, on decayed conifer wood, 16 June 1999, Roberts GA714, *K(M)* 63260; HOLYWELL PARK, SHELTER TRAIL, on decayed wood, 12 June 1999, Roberts GA632, *K(M)* 116649.

Stypella dubia is a cosmopolitan species, originally described from France and redescribed and illustrated in Roberts (1998). It is distinguished inter alia by its fascicles of thick-walled cystidia. The species has not previously been reported from the Caribbean.

Stypella grilletii (Boud.) P. Roberts, Mycotaxon 69: 223 (1998)

SPECIMENS EXAMINED - JAMAICA. SURREY: St Andrew. HOLYWELL PARK, WATERFALL TRAIL, on decayed wood, 8 June 1999, Roberts GA502, *K(M)* 114683; same location, on fallen stick, 15 June 1999, Roberts GA702, *K(M)* 114684.

Stypella grilletii is a cosmopolitan species, originally described from France and redescribed and illustrated in Roberts (1998). It is distinguished inter alia by producing abundant, tiny, gelatinous-crystalline basidiomes which coalesce to form an effused, tuberculate, and ultimately smooth, compound basidiome. The species has not previously been reported from the Caribbean.

Tremellodendron tenue Burt, Ann. Missouri Bot. Gard. 2: 740 (1915)

This little-known clavarioid species, described from Jamaica, has sparsely branched basidiomes and fusiform basidiospores, 14 – 16 x 6 – 7 μm . It was redescribed by Lowy (1971).

Tremelloscypha gelatinosa (Murrill) Oberw. & K. Wells, in Wells & Oberwinkler, Mycologia 74: 325 (1982)

This is a sebacinoid species, growing on decayed wood and resembling a stipitate stereoid fungus. The species was described from Trelawny parish in Jamaica and is otherwise only known from Florida, USA. It was extensively reviewed and illustrated by Wells & Oberwinkler (1982).

Platyglloeales

Achroomyces dennisii P. Roberts sp. nov.

Fig. 6

Basidiomata nulla, in hymeniis parasitica. *Hyphae* 2 – 3 μm latae, fibulatae. *Conidia* elongata, fusiformia, 8.5 – 16 x 2 – 3 μm . *Basidia* cylindracea, ter transeptata, 25 – 30 x 4 – 5 μm , e probasidiis exorientia. *Basidiosporae* ovoideae, 7.5 – 8.5 x 2.5 – 3.5 μm .

Holotype: JAMAICA. SURREY: St Andrew. KINGSTON, MONA, in hymenium of *Hyphodontia sambuci* (Pers.) J. Erikss. on dead grass stems, 2 Jan. 1950, Dennis J165/b, *K(M)* 121772.

Basidiomes intrahymenial in host; not macroscopically visible.

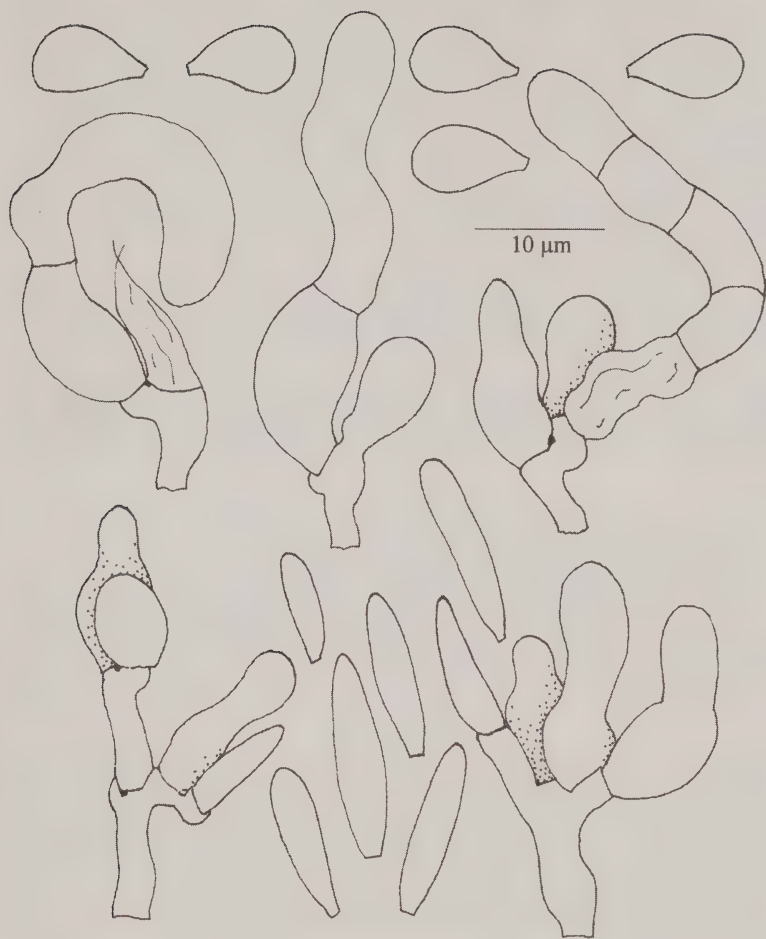


Fig. 6. *Achroomyces dennisii* (Jamaica, holotype, K(M) 121772). Basidiospores; basidia arising from swollen probasidia; immature basidia alongside attached conidia; detached conidia.

Hyphae hyaline, 2 - 3 μm wide, thin-walled, with clamp-connexions; **haustorial cells** none seen; **conidiophores** not distinct; **conidia** elongated fusiform to narrowly clavate, 8.5 - 16 x 2 - 3 μm, arising from clamps alongside probasidia; **cystidia** absent; **basidia** auricularioid, 4-celled, tubular, 25 - 30 x 4 - 5 μm, arising from swollen, thin-walled probasidia 6 - 8 μm wide; **sterigmata** not clearly seen; **basidiospores** ovoid ($Q = 1.6 - 1.7$), 7.5 - 8.5 x 2.5 - 3.5 μm, often ventrally flattened or depressed, germination not seen.

Achroomyces dennisii is distinguished by its corticioid host, its triseptate basidia arising from swollen probasidia, its narrow, elongated conidia, and its ovoid basidiospores. The conidia appear to arise from clamp-connexions alongside immature probasidia, and no distinct conidiophores were seen. As basidia mature, the contents of the probasidia are evacuated and the probasidial walls collapse. Something similar may happen to the basidia at the point of spore release, since no spore-bearing basidia could be found in mounts.

Three additional auricularioid parasites are known from *Hyphodontia sambuci* in Europe: *Achroomyces lumbricifer* P. Roberts, which differs inter alia in its distinctly coiled basidia lacking probasidia; *Achroomyces lunaticonidiatus* Van de Put, which has small, lunate conidia; and *Spiculogloea occulta* P. Roberts, which has spiculate basidia, haustorial cells, and conidia under 5 µm long. *Achroomyces robertsii* Trichies, known from *Hyphodontia nespori* (Bres.) J. Erikss. & Hjortstam, lacks probasidia and has subglobose basidiospores.

Achroomyces Bonord. contains a mixture of mycoparasitic auricularioid species not assigned elsewhere. As such, it is the appropriate genus for this new Jamaican species, pending further research into its septal pore ultrastructure and interaction with its host.

Platycarpa polypodii (Couch) Couch, Mycologia 41: 428 (1949)

Septobasidium polypodii Couch, J. Elisha Mitchell Sci. Soc. 44: 255 (1929)

Platycarpa polypodii is an auricularioid parasite of ferns (*Polypodium* spp), described from Jamaica and originally placed in *Septobasidium*, a genus now restricted to parasites of scale insects (see below). The species was redescribed and illustrated in Oberwinkler & Bandoni (1984).

Septobasidiales

Septobasidium species are effused, possess auricularioid basidia, and are associated with scale insects on living plants. Collections from Jamaica were described and illustrated by Couch (1929) and included in his world monograph (Couch 1938). He appears to have used different systems for numbering specimens in his two publications, which make the identification of isotypes unclear. All his 1926 collections of newly described species are at least paratypes, however, and are so marked below.

Septobasidium alveolatum Couch, J. Elisha Mitchell Sci. Soc. 44: 253 (1929)

SPECIMENS EXAMINED - JAMAICA. SURREY: Portland. MOSSMAN'S PEAK, on living deciduous tree, 30 June 1926, Couch 8543, PARATYPE, *K(M)* 116616; BLUE MOUNTAINS, unlocalized, Sum. 1926, Couch 160, PARATYPE, *K(M)* 116617.

The species is distinguished by its 4-celled basidia with persistent probasidia and by its alveolate (honeycomb-like) middle layer. Type material (two collections cited above) is from the Blue Mountains.

Septobasidium arboreum (Couch) Boedijn & B.A. Steinm., Bull. Jard. Bot. Buitenzorg III, 11: 168 (1931)

SPECIMENS EXAMINED - JAMAICA. SURREY: BLUE MOUNTAINS, unlocalized, on living *Psychotria* sp., 1926, Couch 113, **PARATYPE**, *K(M)* 116625; same details, July 1926, Couch 8550, **PARATYPE**, *K(M)* 116626.

The basidia of this species are four-celled, lacking a probasidial cell. The basidiomes are thin and granular. Couch (1929, 1938) only mentioned a single collection of this species dated June 1926, but the specimens cited above are both marked as 'types'.

Septobasidium areolatum Couch, J. Elisha Mitchell Soc. 44: 248 (1929)

SPECIMENS EXAMINED - JAMAICA. SURREY: Portland. MOSSMAN'S PEAK, on living deciduous tree, 2 July 1926, Couch 8537, **ISOTYPE**, *K(M)* 116614; same details, Couch 123, **PARATYPE**, *K(M)* 116615.

The species is distinguished by its areolate basidiomes and two-celled basidia, rather similar to those of *S. jamaicaense* (below), but distinctly smaller. Type material (two collections cited above) is from the Blue Mountains.

Septobasidium atropunctum Couch, J. Elisha Mitchell Soc. 44: 251 (1929)

SPECIMENS EXAMINED - JAMAICA. SURREY: St Andrew. CINCHONA (NEAR) on living deciduous tree, July 1926, Couch 144, **PARATYPE**, *K(M)* 116623; same details, Sum. 1926, Couch 8548, **PARATYPE**, *K(M)* 116624.

Septobasidium atropunctum has four-celled basidia and develops individual oval compartments or 'houses' for its insect hosts (see Couch 1938). Type material (two collections cited above) is from the Blue Mountains.

Septobasidium fragile Couch, The genus *Septobasidium*: 196 (1938)

This thin species has four-celled basidia and a persistent probasidium. It was originally described from the Blue Mountains (Couch 1938).

Septobasidium jamaicaense Burt, Ann. Missouri Bot. Gard. 3: 333 (1916)

SPECIMENS EXAMINED - JAMAICA. SURREY: Portland. PORTLAND GAP, on living *Solanum punctulatum*, July 1926, Couch 8525, *K(M)* 116618; BLUE MOUNTAINS, unlocalized, on living *S. punctulatum*, July 1926, Couch 136, *K(M)* 116619; BLUE MOUNTAINS, unlocalized, on living trunk of *Eupatorium critoniforme*, 31 Aug. 1986, comm. B. Ing, *K(M)* 116613.

Septobasidium jamaicaense is distinguished by its extensive, greyish-purplish, distinctly chambered basidiomes and by its comparatively large, two-celled basidia. The species was originally described from the Blue Mountains and Couch (1938) noted a further 25 collections from the area, mostly on *Solanum punctulatum*. A note with the specimen on *Eupatorium critoniforme* (cited above) states that the same fungus was also seen on *Solanum*.

Septobasidium purpureum Couch, J. Elisha Mitchell Soc. 44: 255 (1929)

SPECIMEN EXAMINED - JAMAICA. SURREY: St Andrew. CINCHONA, on branch of living deciduous tree, July 1926, Couch 146, **SYNTYPE**, *K(M)* 116621.

The species is distinguished primarily by its unusual, aseptate, monosporic basidia and was originally described from the Blue Mountains (type cited above).

Septobasidium rhabarbarinum (Mont.) Bres., Ann. Mycol. 14: 240 (1916)

Septobasidium frustulosum (Berk. & M.A. Curtis) Pat., Bull. Soc. Mycol. France 10: 79 (1894)

SPECIMENS EXAMINED - JAMAICA. SURREY: St Andrew. CINCHONA (NEAR), on branch of living deciduous tree, July 1926, Couch 8551 (as *S. frustulosum*), *K(M)* 116735; same details, Couch 157 (as *S. frustulosum*), *K(M)* 116736.

This is a cosmopolitan species distinguished by its yellowish basidiome and four-celled basidia lacking probasidia. It was first reported from Jamaica by Couch (1929) under the name *Septobasidium frustulosum*, later (Couch 1938) synonymized with *S. rhabarbarinum*.

Septobasidium septobasidioides (Henn.) Höhn. & Litsch., Sb. Akad. Wiss. Wien Math.-Nat. Kl. I, 116: 757 (1907)

Septobasidium papyraceum Couch, J. Elisha Mitchell Sci. Soc. 44: 249 (1929)

SPECIMENS EXAMINED - JAMAICA. CORNWALL: Trelawny. CROWLANDS, on dead wood, 10 June 1999, L. Ryvarden 41585, *K(M)* 82502; SURREY: BLUE MOUNTAINS, unlocalized, on *Psychotria* wood, July 1926, Couch 8501, **PARATYPE** of *Septobasidium papyraceum*, *K(M)* 85320; same details, Couch 8505, **PARATYPE** of *S. papyraceum*, *K(M)* 85321; PORTLAND. PORTLAND GAP, on *Psychotria* wood, 10 July 1926, Couch 131, **PARATYPE** of *S. papyraceum*, *K(M)* 85319.

Septobasidium septobasidioides was originally described from Brazil and reported from Jamaica by Couch (1929) under the synonym *S. papyraceum*. It is distinguished by its four-celled basidia lacking probasidia and by the unusual 'winged' margins of the basidiomes.

*Tremellales**Tremella coffeicolor* (Berk.) P. Roberts, Kew Bull. 59: 99 (2004)

Tremella auricularia Möller, Protobasid.: 113 (1895)

Basidiome gelatinous, foliaceous, c. 15 mm across, tawny to rusty brown.

Hyphae easily seen, in a fairly soft, gelatinous matrix, hyaline or with gold-yellowish contents, 1 - 3 µm wide, thin-walled, with clamp-connexions; **haustorial cells** not seen; **conidiophores** occasionally present in hymenium, branched, giving rise to botryose clusters of conidia; **conidia** arising from conidiophores and basidiospores, mostly ovoid, 3 - 5 x 2 - 3 µm; **basidia** tremelloid, 4-celled, globose to ellipsoid, 15 - 17 x 14 - 15 µm; **sterigmata** long, narrow, and sinuous; **basidiospores** mostly ellipsoid ($Q = 1.4 - 1.7 (-1.9)$), (8 -) 9.5 - 12 (- 14) x 6 - 8 (- 9) µm, germination by germ tube or the production of yeast cells (conidia).

SPECIMEN EXAMINED - JAMAICA. SURREY: St Andrew. CLYDESDALE, on wood, 16 June 1999, D.J. Lodge (Roberts GA719), *K(M)* 116850.

Tremella coffeicolor is macroscopically similar to smaller specimens of the common, European *T. foliacea* Pers. Microscopically, it differs in its substantially larger basidia and basidiospores. The species, originally described from Bermuda, was illustrated and described from Brazil (as *T. auricularia*) in Roberts & de Meijer (1997) and from the Azores in Roberts & Spooner (2004).

The Jamaican specimen is more orange-brown than noted for the Azores collections, but well within the variation seen in Brazilian material.

***Tremella fuciformis* Berk.,** Hooker's J. Bot. Kew Gard. Misc. 8: 277 (1856)

Tremella fuciformis is a common, pantropical species, distinguished by its delicate, white, fuciform basidiomes, small basidia and basidiospores (illustrated in Roberts & de Meijer 1997). It is parasitic on or associated with species of the ascomycetous genus, *Hypoxylon* Bull. (fide Chen, 1998) and was reported from Jamaica (St Ann) by Lowy (1971).

***Tremella mesenterica* Retz.,** Kongl. Vet. Acad. Handl. 30: 249 (1769)

Tremella mesenterica is a cosmopolitan species, bright yellow and lobate, associated with mycelia of species in the corticioid genus *Peniophora* Cooke. It was reported from Jamaica (St Thomas) in Minter et al. (2001) and recorded from the Dominican Republic by Roberts (2003b). The species was described and illustrated from England in Roberts (1995).

***Tremella olens* Berk.,** in Hooker, Fl. Tasm. II: 262 (1859 ['1860'])

Tremella fibulifera Möller, Protobas. 119 (1895)

SPECIMEN EXAMINED - JAMAICA. SURREY: Portland. HOLYWELL PARK, OATLEY MOUNTAIN TRAIL, on fallen wood, 10 June 1999, Roberts GA562, *K(M)* 113744.

Tremella olens is widespread in tropical and subtropical areas. It is distinguished by its pustular to lobed, whitish-hyaline basidiomes, thin- to thick-walled, gelatinized hyphae, and ellipsoid basidiospores. The species was reviewed and illustrated in Roberts (2001) based on African and Asian material together with the Australian type collection. Collections from Venezuela were described in Roberts (2003a). *Tremella fibulifera*, originally from Brazil, was redescribed and illustrated from that country by Roberts & de Meijer (1997). The type has thinner-walled hyphae than the type of *T. olens*, but otherwise the two taxa appear to be conspecific. *Tremella olens* has not previously been reported from the Caribbean.

Tulasnellales

***Tulasnella cystidiophora* Höhn. & Litsch.,** Sb. Akad. Wiss. Wien Math.-Nat. Kl. I, 115: 1557 (1906)

SPECIMEN EXAMINED - JAMAICA. SURREY: St Andrew HOLYWELL PARK, OATLEY MOUNTAIN TRAIL, on partly fallen branch, 15 June 1999, Roberts GA693, *K(M)* 63257.

Tulasnella cystidiophora is distinguished inter alia by its conspicuous gloeocystidia. Originally described from Finland, the species was redescribed and illustrated by Roberts (1994). It has not previously been recorded from the Caribbean.

Tulasnella eichleriana Bres., Ann. Mycol. 1: 113 (1903)

SPECIMEN EXAMINED - JAMAICA. SURREY: St Andrew. HOLYWELL PARK, WATERFALL TRAIL, on fallen wood, 8 June 1999, Roberts GA518, *K(M)* 63179.

Originally described from Poland, *Tulasnella eichleriana* is a cosmopolitan species or species complex, redescribed and illustrated by Roberts (1994). The species can be recognized by its effused, ceraceous, grey-violaceous basidiomes, clampless hyphae, and small, subglobose to ellipsoid basidiospores. *Tulasnella eichleriana* was reported from the Dominican Republic by Roberts (2003b), but has not previously been recorded from Jamaica.

Tulasnella tomaculum P. Roberts, Mycol. Res. 97: 215 (1993)

SPECIMEN EXAMINED - JAMAICA. SURREY: St Andrew. HOLYWELL PARK, WATERFALL TRAIL, on fallen wood, 8 June 1999, Roberts GA516, *K(M)* 63272.

Tulasnella tomaculum is a cosmopolitan species, originally described from England in Roberts (1993), but not previously reported from the Caribbean. The species is similar to *T. eichleriana* (above), but differs in its weakly allantoid basidiospores.

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New taxa of the lichen genus *Pertusaria* (Ascomycota) from Thailand

SUREEPORN JARIANGPRASERT

s_vipoosunti@yahoo.com

Department of Biology, Faculty of Science, Maejo University
Chiang Mai 50290, Thailand

Abstract—*Pertusaria alboaspera* var. *disflavens*, *P. kansriae* var. *stictica*, *P. methylstenosporica*, *P. microstoma* var. *isidiata*, *P. neoknightiana*, *P. orientalis*, *P. parameeana*, *P. phulhuangensis*, *P. pilosula* var. *abditiva*, *P. platycarpa*, *P. subcopelandii* and *P. subplanaica* var. *stictica* from Thailand, are reported as new to science.

Key words—lichens, taxonomy

Introduction

Thailand is a tropical country with a high biodiversity in vascular plants and animals as well as lichens. As an example, Homchantara & Coppins (2002) recently described more than thirty new species of *Thelotrema* from Thailand. The twelve taxa in the lichen genus *Pertusaria* described below were found to be new to science. These taxa were described and illustrated as species 1–12 in the keys to the 113 species of *Pertusaria* found in Thailand (Jariangprasert 2005). The techniques used for identification of lichen compounds, thin layer chromatography (TLC) and high performance liquid chromatography (HPLC), were as described previously (Jariangprasert & Archer 2002–2004).

Taxonomic Descriptions

Pertusaria alboaspera var. *disflavens* Jariangprasert var. nov.

Figure 1

Sicut *Pertusaria alboaspera* sed *lichexanthone deficiens*.

Etymology: the epithet *disflavens* is from the Latin *dis*, not, and *flavens*, yellowing, a reference to the absence of the yellow fluorescence due to the lichexanthone present in var. *alboaspera*.

Holotype: THAILAND. Chiang Mai Province: Mueang District, Doi Suthep-Pui National Park, in woodpile of hill tribe, 1340 m, on bark of *Litchi chinensis*, S. Jariangprasert 1663, 16.vii.2001; holotype: QSBG.

KEY CHARACTERS—**Thallus** corticolous, greyish green, surface dull, slightly cracked, isidia and soredia absent. **Apothecia** verruciform, conspicuous, numerous and scattered, sometimes confluent, 0.5–0.8 mm diam. **Ostioles** hyaline to grey, inconspicuous, 1–4 per

apothecium. **Ascospores** (6-)8 per ascus, basally biseriate, subfusiform-ellipsoid, 65-85 μm long, 27-35 μm wide; smooth, outer ascospore wall 5-10 μm thick.

Chemistry—K+ yellow, KC-, C-, Pd+ orange, UV-; 2,2'-di-O-methylstenosporic acid (major), stictic acid (major) and constictic acid (minor).

Substrate and Distribution—*Pertusaria alboaspera* var. *disflavens* is a rare corticolous taxa known only from a specimen collected in Doi Suthep Pui National Park, Chiang Mai Province, northern Thailand. It grows on *Litchi* at an altitude of 1340 m.

COMMENTS—*Pertusaria alboaspera* var. *disflavens* is characterised by asci with eight ascospores and the presence of 2,2'-di-O-methylstenosporic and stictic acids. The new species differs from *P. alboaspera* A.W. Archer & Elix var. *alboaspera* in lacking lichexanthone (Archer & Elix 1993).

***Pertusaria kansriae* var. *stictica* Jariangprasert var. nov.**

Figure 2

Similis *Pertusaria kansriae* sed *acidum sticticum continens differt*.

Etymology: from the presence of stictic acid.

Holotype: THAILAND. Phitsanulok Province: Nakhon Thai District, Phu Hin Rong Kla National Park, behind Ban Pha Chu Thong guest house, 1100 m, on bark of *Artocarpus heterophyllus*, S. Jariangprasert 2132, 20.i.2002; holotype: QSBG.

KEY CHARACTERS—**Thallus** corticolous, buff or off-white to ivory, surface smooth and shiny, areolate, isidia and soredia absent. **Apothecia** verruciform, conspicuous, flattened hemispherical, not confluent, not constricted at base. **Ostioles** hyaline, inconspicuous, or rarely pale brown conspicuous, 1 per apothecium. **Ascospores** sometimes 4-5 per ascus, uniseriate, or 8 per ascus, irregularly basally biseriate, subfusiform to ellipsoid, (50-)80-94 μm long, 25-44 μm wide, outer ascospore wall 4-10 μm thick.

Chemistry—K+ yellow, KC-, C-, Pd+ red orange, UV+ salmon orange to orange; 4,5-dichlorolichexanthone (minor), 2'-O-methylstenosporic acid (major), stictic acid (minor) and constictic acid (minor).

Substrate and Distribution—*Pertusaria kansriae* var. *stictica* occurs in Phu Hin Rongkla National Park, Phitsanulok Province in northern Thailand and is uncommon in Chiang Mai and Loei Provinces. It grows on *Peltophorum*, *Phyllanthus* and *Schima* at altitudes between 600 and 1100 m.

COMMENTS—*Pertusaria kansriae* var. *stictica* is characterised by asci with eight uniseriate ascospores and the presence of 4,5-dichlorolichexanthone, 2'-O-methylstenosporic and stictic acids. The species resembles *P. kansriae* Jariangprasert (Jariangprasert & Anusarnsunthorn 2005) but is differentiated from that species by the presence of stictic acid and the number of ascospores per ascus.

ADDITIONAL SPECIMENS EXAMINED—THAILAND. Chiang Mai Province: Mae Rim District, The Queen Sirikit Botanic Garden, on slope next to fern plot, 640 m, on bark of *Peltophorum pterocarpum* in evergreen forest, K. Boonpragob s.n., 25.i.1994, RU 273 (RAMK). Phitsanulok Province: Nakhon Thai District, Phu Hin Rong Kla National Park, opposite the headquarters, 1100 m, on bark of *Phyllanthus emblica* in pine plantation, S. Jariangprasert 1923, 1925, 1932, 1943, 19.i.2002 (QSBG). Loei Province: Nahaeo District, Nahaeo National Park, at a bridge to Na Po, 720-750 m, on bark of *Schima wallichii* in dry evergreen forest, N. Homchantara s.n., 4.iv.1995, RU 7622 (RAMK).

Pertusaria methylstenosporica Jariangprasert sp. nov.

Figure 3

Similis *Pertusaria novaeguineae* sed *acidium* 2'-O-methylperlatolicum *deficiens*.

Etymology: the epithet *methylstenosporica* refers to the presence of methyl 2'-O-methylstenosporate in the new species.

Holotype: THAILAND. Chiang Mai Province: Jom Thong District, Doi Inthanon National Park, gateway to Ban Pha Mhon, 1040 m, on tree trunk, in pine forest, S. Jariangprasert 2459, 13.iii.2002; holotype: QSBG.

KEY CHARACTERS—**Thallus** corticolous, olive green to green, surface smooth and shiny, isidia and soredia absent. **Apothecia** verruciform, conspicuous, flattened hemispherical, constricted at base, rarely confluent, sometimes cracked, 1-2 apothecia per verruca, 0.5-1.0 mm diam. **Ostioles** grey-black, conspicuous, fused in a central depression, 1-4 per apothecium, 1-8 per verruca. **Ascospores** 2-3 per ascus, subfusiform to ellipsoid-cylindrical, (100-)118-150 µm long, 35-50 µm wide; smooth, outer ascospore wall 6-12 µm thick.

Chemistry—K+ yellow, KC-, C-, Pd+ orange, UV-; methyl 2'-O-methylstenosporate (major), planaic acid (minor), 2-O-methylperlatolic acid (minor), methyl 2-O-methylperlatolate (minor), methyl planaiate (minor), stictic acid (major) and constictic acid (trace).

Substrate and Distribution—*Pertusaria methylstenosporica* is a rare, endemic, corticolous species, known only the type specimen from Doi Inthanon National Park, Chiang Mai, in the north of Thailand. It grows in pine forest at an altitude of 1040 m.

COMMENTS—*Pertusaria methylstenosporica* is distinguished from other *Pertusaria* species with two smooth ascospores per ascus by the presence of methyl 2'-O-methylstenosporate. This substance is rarely found as a major compound but occurs in *P. alboaspera* var. *tetraspora* Jariangprasert (Jariangprasert & Anusarnsunthorn 2005). The species is morphologically similar to *P. novaeguineae* A.W. Archer & Elix but has a different chemistry; *Pertusaria novaeguineae* contains 2'-O-methylperlatolic acid (Archer & Elix 1998a).

Pertusaria microstoma var. *isidiata* Jariangprasert var. nov.

Figure 4

Similis *Pertusaria microstoma* sed *isidiis* *differt*.

Etymology: the epithet *isidiata*, refers to the isidiate thallus.

Holotype: THAILAND. Tak Province: Mueang District, Tambon Mae To, Lan Sang National Park, trail to Musoe Dam-Musoe Lhueang Agricultural Station, Pha Daeng unit, 970 m, on bark of *Knema linifolia* in evergreen forest, S. Jariangprasert 3918, 20.xi.2002; holotype: QSBG; topotype: S. Jariangprasert 3919: RAMK.

KEY CHARACTERS—**Thallus** corticolous, greyish green, surface smooth, dull, isidiate, soredia absent. **Isidia** simple to coralloid, numerous, dense, concolourous with the thallus, 0.2-0.8 mm long, 0.1 mm diam. **Apothecia** verruciform, conspicuous, subglobose to hemispherical, numerous, crowded, constricted at the base, 0.3-0.8 mm diam. **Ostioles** black, conspicuous, slightly depressed, 1-2(-4) per apothecia. **Ascospores** (1-)2-3 per ascus, ellipsoid, (80-)82-92(-106) µm long, (32-)36-44 µm wide; rough, outer ascospore wall 6-10 µm thick.

Chemistry—K+ pale yellow, KC-, C-, Pd+ orange, UV+ orange red; 4,5-dichlorolichexanthone (minor), 2'-O-methylperlatolic acid (major), stictic acid (minor) and constictic acid (minor-trace).

Substrate and Distribution—*Pertusaria microstoma* var. *isidiata* is an uncommon corticolous species. Three of the four specimens were found in Tak Province in northern Thailand whereas the remaining specimen was collected in Phetchaburi Province in southwest Thailand. It grows on *Knema* at altitudes between 600 and 1000 m.

COMMENTS—*Pertusaria microstoma* var. *isidiata* is characterised by the isidiate thallus, two rough ascospores per ascus and the presence of 4,5-dichlorolichexanthone, 2'-O-methylperlatolic and stictic acids. The new variety is chemically identical to *P. microstoma* Müll. Arg. (Archer 1997) but that species lacks isidia, and to *P. bundiensis* A.W. Archer & Elix (Archer & Elix 1998b) but that species has larger ascospores, 150–170 µm long.

ADDITIONAL SPECIMENS EXAMINED—THAILAND. **Tak Province:** type locality, *S. Jariangprasert* 3759, 20.xi.2002. **Phetchaburi Province:** Kaeng Krachan National Park, by side of road beyond 28 km marker, 600 m, on fallen log, in moist evergreen forest, *S. Jariangprasert* 2521, 12.vi.2002 (QSBG).

Pertusaria neoknightiana Jariangprasert sp. nov.

Figure 5

Sicut Pertusaria knightiana sed ascosporis minoribus et parietibus interioribus laevis differt.

Etymology: from the Latin, *neo*, new, and a reference to *Pertusaria knightiana*.

Holotype: THAILAND. Phitsanulok Province: Nakhon Thai District, Phu Hin Rong Kla National Park, behind Ban Pha Chu Thong guest house, 1100 m, on bark of *Mangifera indica* in pine plantation, *S. Jariangprasert* 2118, 20.i.2002; *holotype:* QSBG.

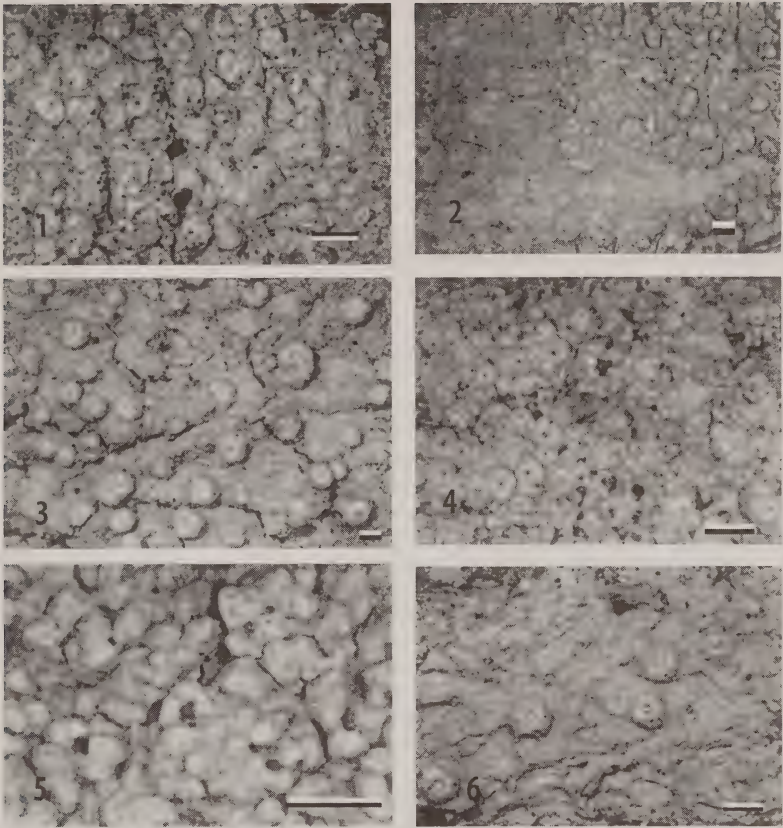
KEY CHARACTERS—**Thallus** corticolous, pale greyish green, surface subtuberculate, glossy, with crystals below the cortex, lacking isidia and soredia. **Apothecia** verruciform, inconspicuous, rarely confluent, 0.4–0.9 mm diam. **Ostioles** conspicuous, grey-black, immersed in a central depression, 1 per apothecium. **Ascospores** 2 per ascus, ellipsoid, (54-)86–122 µm long, (24-)36–46 µm wide; smooth, outer ascospore wall 6–10 µm thick.

Chemistry—K+ yellow then red, KC-, C-, Pd +yellow, UV+ strong yellow orange; 4,5-dichlorolichexanthone (minor), norstictic acid (major) and connorstictic acid (minor).

Substrate and Distribution—*Pertusaria neoknightiana* is a corticolous species, sparsely distributed in two provinces of northern Thailand. It grows on *Dalbergia*, *Mangifera* and *Prunus* at altitudes between 100 and 1300 m.

COMMENTS—*Pertusaria neoknightiana* is characterised by asci with two smooth ascospores and the presence of 4,5-dichlorolichexanthone and norstictic acid. The new species is chemically similar to *P. knightiana* Müll. Arg., a saxicolous species from New Zealand and Australia, but that species has rough ascospores.

ADDITIONAL SPECIMENS EXAMINED—THAILAND. **Chiang Mai Province:** Chiang Dao District, Huai Nam Dang National Park, Noen Phee Lhok, 1300 m, on Fagaceae, *S. Jariangprasert* 4518.2, 24.xii.2002 (QSBG); *ibid.*, on *Dalbergia*, in evergreen forest, *S. Jariangprasert* 4486.2, 24.xii.2002 (QSBG). **Phitsanulok Province:** Nakhon Thai District, Phu Hin Rong Kla National Park, 1030 m, on *Prunus cerasoides* in evergreen forest, *N. Homchantara* NH 42.8(1), 2.v.2003 (RAMK).



Figures 1-6. New taxa of *Pertusaria*. 1. *P. alboaspera* var. *disflavens*, holotype (QSBG); 2. *P. kansriae* var. *stictica*, holotype (QSBG); 3. *P. methylstenosporica*, holotype (QSBG); 4. *P. microstoma* var. *isidiata*, holotype (QSBG); 5. *P. neoknightiana*, holotype (QSBG); 6. *P. orientalis*, holotype (QSBG). Scale bar = 1 mm.

***Pertusaria orientalis* Jariangprasert sp. nov.**

Figure 6

Similis *Pertusaria malviniae* sed *corticola et ascosporis minoribus differt.*

Etymology: from the Latin, *orientalis*, eastern, a reference to the occurrence of the species in Asia.

Holotype: THAILAND. Chiang Mai Province: Mueang District, Doi Suthep-Pui National Park, trail to top of Doi Pui Mountain, 1600 m, in moist evergreen forest, S. Jariangprasert 1672, 16.vii.2001; holotype: QSBG.

KEY CHARACTERS—**Thallus** corticolous, greyish green, surface subtuberculate, rarely wrinkled, cracked and areolate, isidia and soredia absent. **Apothecia** verruciform, conspicuous, flattened hemispherical to irregular, rarely confluent, 0.5-1.3 mm diam.

Ostioles hyaline and inconspicuous to black and conspicuous, surrounded with translucent tissue, some sunken and fused to become pseudolecanorine or slightly raised, 1-3 per apothecia. **Ascospores** 2-3(-4) per ascus, broad ellipsoid-cylindrical, 72-134 µm long, 40-80 µm wide; smooth, outer ascospore wall 6-14 µm thick.

Chemistry—K- or + yellow, KC-, C-, Pd-, UV-; confluent acid (major) and 2'-O-methylmicrophyllinic acid (minor-trace).

Substrate and Distribution—*Pertusaria orientalis* is a common corticolous species in Chiang Mai Province in the north but uncommon in Loei and Tak Provinces in the northeast Thailand. It grows on *Anacolosa*, *Artocarpus*, *Cinnamomum*, *Docynia*, *Eurya*, *Phyllanthus*, *Prunus* and *Senna* at altitudes between 100 and 1700.

COMMENTS—*Pertusaria orientalis* is characterised by asci with two predominantly smooth ascospores and the presence of confluent acid. The Thai specimens are chemically similar to the saxicolous species *P. malviniae* Messuti & A. W. Archer from the Falkland Islands (Messuti & Archer 1999) but differ from that species by substrate preference and number of ascospores. In *P. orientalis* there are two to three, rarely four (immature) ascospores per ascus in contrast to the four-spored asci in *P. malviniae*.

ADDITIONAL SPECIMENS EXAMINED—THAILAND. Chiang Rai Province: Phan District, Tambon Pa Hung, Doi Lhuang National Park, Pang Pa Gluay and Pang Ma Kham Pom, 1210 m, on Fagaceae, in evergreen forest, *S. Jariangprasert* 3568, 14.xi.2002 (QSBG). Chiang Mai Province: Mueang District, Doi Suthep-Pui National Park, behind headquarters, 1100 m, on *Artocarpus heterophyllus* in evergreen forest, *S. Jariangprasert* 2667.2, 17.ix.2002 (QSBG); *ibid.*, a trail to Ban Maeo Community, 1450 m, on bark of Fagaceae, in evergreen forest, *S. Jariangprasert* 1680, 16.vii.2001 (QSBG); *ibid.*, 1300 m, a trail behind Ban Mong Doi Pui, Moo 4 Ban Khun Chang Khian, *S. Jariangprasert* 2591.2, 16.ix.2002 (QSBG); *ibid.*, trail behind Ban Maeo Community, 1340 m, on *Senna floribunda* in evergreen forest, *S. Jariangprasert* 1664, 1672, 16.vii.2001 (QSBG); Fhang District, Angkhang, opposite crossroad to Mae Phoe Headwaters catchment, 1520 m, on *Docynia indica*, *S. Jariangprasert* 2849, 29.ix.2002 (QSBG); Chiang Dao District, Huai Nam Dang National Park, around welfare restaurant, 1540-1680 m, on *Eurya acuminata* var. *wallichiana*, *S. Jariangprasert* 4583, 4588, 4589, 4590, 4659, 4702.1, 4735, 4736, 4739, 25.xii.2002 (QSBG); *ibid.*, behind welfare restaurant, 1580 m, on unidentified tree, *S. Jariangprasert* 4717, 25.xii.2002 (QSBG); behind welfare shop, 1600 m, on *Cinnamomum*, *S. Jariangprasert* 4572, 4579.2, 25.xii.2002 (QSBG); *ibid.*, on Euphorbiaceae, *S. Jariangprasert* 4613, 4617.2, 25.xii.2002 (QSBG); roadside to Sone Doi, 1600 m, on *Eurya acuminata* var. *wallichiana*, *S. Jariangprasert* 4743, 25.xii.2002 (QSBG); *ibid.*, Sone Doi, tent area, 1680 m, on *Prunus cerasoides* in evergreen forest with pines, *S. Jariangprasert* 4633, 25.xii.2002 (QSBG); *ibid.*, view point, 1440 m, on Euphorbiaceae, *S. Jariangprasert* 4640, 25.xii.2002 (QSBG); *ibid.*, roadside to the new palace, 1540 m, *S. Jariangprasert* 4660, 25.xii.2002 (QSBG); *ibid.*, 62-63 km, Noen Phee Lhok, 1300 m, on Fagaceae, in evergreen forest, *S. Jariangprasert* 4427, 24.xii.2002 (QSBG); Jom Thong District, Doi Inthanon National Park, at twenty-seventh kilometre stone, 1060 m, in deciduous/pine forest, *S. Jariangprasert* 2468, 13.iii.2002 (QSBG); *ibid.*, left hand side of gateway to Ban Lung Daeng, 1300 m, on *Phyllanthus emblica*, *S. Jariangprasert* 4804, 25.xii.2002 (QSBG); Omkoi District, Tambon Mon Jong, Ban Mae Toen, Omkoi Wildlife Sanctuary, in front of Musoe unit, 1340 m, on cultivated *Senna floribunda* in evergreen forest with pines, *S. Jariangprasert* 4215, 17.xii.2002 (QSBG); *ibid.*, on unidentified tree, *S. Jariangprasert* 4228.2, 17.xii.2002 (QSBG); *ibid.*, Mae La Meed Lhuang, 1440 m, on *Carallia brachiata*, *S. Jariangprasert* 4346, 4363, 4368.1, 4382,

4394.1, 19.xii.2002 (QSBG); *ibid.*, on vine, *S. Jariangprasert* 4391.1, 19.xii.2002 (QSBG); *ibid.*, on *Anacolosa ilicoides*, *S. Jariangprasert* 4388, 19.xii.2002 (QSBG). **Tak Province:** Mueang District, Tambon Mae To, Lan Sang National Park, between Tak Province and Mae Sod District, on the way to Musoe Dam and Musoe Lhueang Agricultural Station, trail to Pha Daeng unit, 1020 m, on Fagaceae, in evergreen forest, *S. Jariangprasert* 3803, 20.xi.2002 (QSBG). **Loei Province:** Phu Lhuang Wildlife Sanctuary, in front of Song Phra Jaroen placard, 1460 m, on bark of *Lithocarpus truncatus* in oak/chestnut forest, *S. Jariangprasert* 2298, 3.ii.2002 (QSBG).

***Pertusaria parameeana* Jariangprasert sp. nov.**

Figure 7

Sicut Pertusaria meeana sed ostioliis nigris et acida perlatolicum et dihydropicrolichenicum continens differt.

Etymology: from the Greek *para*, near, a reference to the similarity of the new species to *Pertusaria meeana*.

Holotype: THAILAND. Chiang Mai Province: Mae Rim District, The Queen Sirikit Botanic Garden, opposite the headquarters building, 650–730 m, on bark of *Semecarpus albens* in dry dipterocarp forest, *K. Boonpragob s.n.*, 17.i.1995; holotype: RU 3817 (RAMK); topotype: RU 3824 (RAMK).

KEY CHARACTERS—**Thallus** corticolous, dark green, surface rough, subtuberculate, isidia and soredia absent. **Apothecia** verruciform, conspicuous, flattened hemispherical, constricted at base, confluent, 1–3 apothecia per verruca, 0.5–0.8 mm diam. **Ostioles** black, conspicuous, sunken, sometimes fused, 1–5 per apothecia. **Ascospores** (1–)2(–3) per ascus, rarely 4 (then immature), ellipsoid, (80–)105–137(–140) μm long, (35–)40–60 μm wide; smooth, outer ascospore wall 10–17 μm thick.

Chemistry—K–, KC–, C–, Pd–, UV+ salmon orange; atranorin (trace), 4,5-dichlorolichexanthone (minor), 2-*O*-methylperlatolic acid (major), perlatolic acid (trace), dihydropicrolichenic acid (trace) and $\pm$ 2-*O*-methylstenosporic acid (trace).

Substrate and Distribution—*Pertusaria parameeana* is a corticolous species, found in several northern provinces and rarely in the southwest. It grows on *Dipterocarpus*, *Semecarpus* and *Shorea* at altitudes between 370 and 1300 m.

COMMENTS—*Pertusaria parameeana* is characterised by asci with two smooth ascospores and the presence of 2-*O*-methylperlatolic acid and 4,5-dichlorolichexanthone. The species is chemically similar to the Australian species *P. meeana* A.W. Archer & Elix but differs in morphology and trace compounds. *Pertusaria meeana* has inconspicuous, punctiform, translucent ostioles and flattened hemispherical verruciform apothecia, and contains the trace compounds 2-*O*-methyhyperlatolic and 2-*O*-methyisohyperlatolic acids (Archer 1997) whereas the new species has sunken, conspicuous black ostioles and constricted apothecia, and contains perlatolic, dihydropicrolichenic and 2-*O*-methylstenosporic acids as trace lichen compounds.

ADDITIONAL SPECIMENS EXAMINED—THAILAND. Chiang Rai Province: Phan District, Tambon Pa Hung, Doi Lhuang National Park, Ban Pang Pu Lo, 1180 m, on Fagaceae, from dry dipterocarp to deciduous forest, *S. Jariangprasert* 3460, 13.xi.2002 (QSBG). Chiang Mai Province: Mueang District, Doi Suthep Pui National Park, 18°48'N, 99°56'E, 650 m, in dry dipterocarp forest, *P. W. James & P. A. Wolseley* 2632, 30.i.1993, (BM); Mae Rim District, The Queen Sirikit Botanic Garden, opposite of the headquarters

building, 900–1100 m, on bark of *Dipterocarpus obtusifolius* in dry dipterocarp forest, K. Boonpragob s.n., 15.i.1995, RU 3615 (RAMK); Huai Nam Dang National Park, Noen Phee Lhok, between the sixty-second and sixty-third kilometres, 1300 m, on Fagaceae, in hill evergreen forest, S. Jariangprasert 4415, 4527, 24.xii.2002 (QSBG). **Lampang Province:** Phao District, Tambon Jae Sawn, Jae Sawn National Park, nature study track round waterfall, 660 m, on *Semecarpus albescens* in evergreen forest, S. Jariangprasert 3067, 3068, 5.xi.2002 (QSBG); *ibid.*, behind the youth camp, opposite waterfall, 740 m, on *Shorea siamensis* in dry dipterocarp forest, S. Jariangprasert 3265, 6.xi.2002 (QSBG). **Uttaradit Province:** Nam Pad District, Ban Huai Mun, Phu Soi Dao National Park, Huai Tao, Ban Coke, 490 m, on *Dipterocarpus obtusifolius* in dry dipterocarp forest, S. Jariangprasert 4009.1, 27.xi.2002 (QSBG). **Tak Province:** Mueang District, Tambon Mae To, Lansang National Park, near waterfall, 480–540 m, on *Shorea*, in dry dipterocarp forest, S. Jariangprasert 3668, 3677, 19.xi.2002 (QSBG). **Uthai Thani Province:** Huai Kha Khaeng Wildlife Sanctuary, 15°35'N, 99°20'E, 500 m, in dry dipterocarp forest, P. A. Wolseley, 1024.1, 10.i.1991, (BM); *ibid.*, Khao Nang Rum, 15°29'N, 99°18'E, 400 m, on *Dipterocarpus*, in dry dipterocarp forest, P. A. Wolseley 5262, 5263, 20.i.1992, (BM); *ibid.*, Valley plot, 370 m, Aguirre, James & Wolseley 3061.1, 12.ii.1993, (BM).

***Pertusaria phulhuangensis* Jariangprasert sp. nov.**

Figure 8

Sicut Pertusaria minor sed ascosporis majoribus et ostioli differt.

Etymology: from the Latin, *ensis*, place of origin, and Phu Lhuang Wildlife Sanctuary.

Holotype: THAILAND. Loei Province: Phu Lhuang Wildlife Sanctuary, behind the Queen's palace, Pha Yueang Cliff, 1470 m, on tree trunk, in oak/chestnut forest, S. Jariangprasert 2193, 3.ii.2002; holotype: QSBG; S. Jariangprasert 2192, topotype: RAMK.

KEY CHARACTERS—**Thallus** corticolous, green, surface smooth, isidia and soredia absent. **Apothecia** verruciform, conspicuous, broadly hemispherical, confluent, 1–4 apothecia per verruca, 0.7–2.3 mm diam. **Ostioles** hyaline to grey, conspicuous, most are poriform, surrounded with white tissue, 1–5 per apothecia. **Ascospores** (5–)6–8 per ascus, uniseriate, subfusiform-ellipsoid, 74–110 µm long, 30–44 µm wide; smooth, some with pores between outer and inner wall, outer ascospore wall 6–10 µm thick.

Chemistry—K- or + yellow, KC-, C-, Pd+ orange, UV-; 2'-O-methylperlatolic acid (major), stictic acid (minor) and peristictic acid (trace).

Substrate and Distribution—*Pertusaria phulhuangensis* is a rare, endemic corticolous species from Phu Lhuang Wildlife Sanctuary, Loei Province, in upper northeastern Thailand. It occurs in oak/chestnut forest at 1470 m.

COMMENTS—*Pertusaria phulhuangensis* is characterised by asci with eight ascospores and the presence of 2'-O-methylperlatolic and stictic acids. The new species differs from the chemically similar species *P. minor* Müll. Arg., from Indonesia, by the larger, uniseriate ascospores, 74–110 x 30–44 µm, compared to 60–80 x 22–32 µm in *P. minor* (Zahlbruckner, 1928). In addition, *Pertusaria minor* has black ostioles in contrast to the hyaline ostioles in *P. phulhuangensis*.

ADDITIONAL SPECIMENS EXAMINED—THAILAND. Loei Province: Phu Lhuang Wildlife Sanctuary, in front of the old palace, 1470 m, on tree trunk, in oak/chestnut forest, S. Jariangprasert 2251, 3.ii.2002 (QSBG); *ibid.*, behind the Queen's palace, Pha Yueang Cliff, 1470 m, on tree trunk, in oak/dipterocarp forest, S. Jariangprasert 2192, 3.ii.2002; topotype: RAMK.

Pertusaria pilosula* var. *abditiva* Jariangprasert var. nov.*Figure 9***Sicut* *Pertusaria pilosula* sed 4,5-dichlorolichexanthone deficiens.*Etymology*: from the Latin, *abditivus*, removed from, a reference to the absence of 4,5-dichlorolichexanthone, present in var. *pilosula*.*Holotype*: THAILAND. Sukhothai Province: Ramkhamhaeng National Park, nature study trail, 450 m, in dry evergreen forest, K. Vongsheawat, 22.x.1997, RU 9509.3 (RAMK).

KEY CHARACTERS—**Thallus** corticolous, olive green, soredia absent, isidiate. **Isidia** initially simple, becoming branched, 0.15–1.0 mm long, 0.1–0.15 mm diam. **Apothecia** unknown.

Chemistry—K-, KC-, C-, Pd-, UV-; 2'-O-methylperlatolic acid (major), stictic acid (minor) and constictic acid (trace).

Substrate and Distribution—*Pertusaria pilosula* var. *abditiva* is an isidiate corticolous species, found predominantly in northern Thailand. It grows on *Ficus* and *Vatica* at altitudes between 140 and 1100 m.

COMMENTS—*Pertusaria pilosula* var. *abditiva* is characterised by an isidiate thallus and the presence of 2'-O-methylperlatolic and stictic acids. It resembles *P. pilosula* A.W. Archer & Elix but is distinguished from that species by the absence of 4,5-dichlorolichexanthone (Archer 1997). The Thai specimens also resemble *P. buburana* Elix & A.W. Archer, an isidiate species from Papua New Guinea, but that species contains only 2'-O-methylperlatolic acid (Elix et al. 1997).

ADDITIONAL SPECIMENS EXAMINED—THAILAND. Chiang Mai Province: Mueang District, Doi Suthep-Pui National Park, 99°54'E, 18°48'N, 1100 m, in moist evergreen forest, P. A. Wolseley & B. Aguirre-Hudson, 24.xi.1991, L 5317 (CMU). Lamphun-Lampang Provinces: Doi Khun Tan National Park, 200 m, 1060 m, on *Ficus*, in evergreen forest, S. Jariangprasert 2943, 24.x.2002 (QSBG); *ibid.*, beyond a shelter between Yo 2 and Yo 3, 1100 m, in hill evergreen forest, S. Jariangprasert 2954, 24.x.2002 (QSBG). Uttaradit Province: Nam Pad District, Ban Huai Mun, Phu Soi Dao National Park, behind waterfall, 800–1000 m, on Fagaceae, in dry dipterocarp/evergreen forest, S. Jariangprasert 4057, 4072, 28.xi.2002 (QSBG); *ibid.*, Ban Coke to Ban Huai Tao, behind big rock, in dry dipterocarp forest, S. Jariangprasert 3983, 27.xi.2002 (QSBG); *ibid.*, 820–1100 m, on bark of unidentified vine, in dry dipterocarp/Fagaceae forest, S. Jariangprasert 4062, 28.xi.2002 (QSBG). Uthai Thani Province: Huai Kha Kaeng Wildlife Sanctuary, Khao Nang Rum, 99°18'E, 15°29'N, 370 m, on *Vatica cinerea* in dry evergreen forest, P. A. Wolseley & B. Aguirre-Hudson, 22.i.1992, L 5394 (CMU); *ibid.*, river to KNR, windy gap pass, 99°15'E, 15°28'N, 900 m, in dry evergreen forest, P. A. Wolseley & B. Aguirre-Hudson, 27.i.1992, 5313 (BM); *ibid.*, 99°18'E, 15°29'N, 370 m, on Rutaceae, in dry evergreen forest, B. Aguirre-Hudson & P. A. Wolseley, 28.i.1992, 5303 (BM); *ibid.*, Khao Kiew, 99°20'E, 15°27'N, 500 m, in evergreen forest, Aguirre, James & Wolseley, 15.ii.1993, 2545 (BM). Nakhon Ratchasima Province: Khao Yai National Park, Nhong Phagshe, 14°27'71"N, 101°22'19"E, 800 m, on *Ficus* fallen log, in dry evergreen forest, S. Jariangprasert 4876, 16.viii.2003 (QSBG). Chantaburi Province: Khao Soi Dao Wildlife Sanctuary, in front of the head office, 280 m, on bark of vine, in dry evergreen forest, S. Jariangprasert 2557, 16.vi.2002 (QSBG). Krabi Province: Khao Panom Benja National Park, close to welfare restaurant, 140 m, on tree trunk, in evergreen forest, S. Jariangprasert 2931, 13.x.2002 (QSBG).

Pertusaria platycarpa* Jariangprasert sp. nov.*Figure 10**

Sicut *Pertusaria* *praetermissa* *sed* *lichexanthone* *continens* *vice* 4,5-dichlorolichexanthone.

Etymology: the epithet *platycarpa* is from the Greek *platys*, broad and *karpos*, fruit, a reference to the flattened apothecia.

Holotype: THAILAND. Loei Province: Phu Lhuang Wildlife Sanctuary, in front of the old palace, 1470 m, on bark of *Acronychia pedunculata* in oak/chestnut forest, *S. Jariangprasert* 2161, 3.ii.2002; holotype: QSBG.

KEY CHARACTERS—**Thallus** corticolous, greyish green, surface dull, slightly wrinkled and cracked, with crystals below the cortex, isidia and soredia absent. **Apothecia** verruciform, conspicuous, flattened hemispherical, constricted at the base, concolourous with the thallus, pale above, rarely confluent, 2-3 per verruca, 0.6-1.1 mm diam. **Ostioles** smooth, translucent, inconspicuous, 1-2 per apothecia. **Ascospores** 8 per ascus, basally irregularly biseriata, subfusiform, 70-110(-134) μ m long, 36-46(-54) μ m wide; smooth, outer ascospore wall 6-12 μ m thick.

Chemistry—K+ yellow, KC-, C-, Pd+ orange, UV+ yellow; lichexanthone (minor), 2'-O-methylstenosporic acid (major), 2'-O-methyldivaricatic acid (trace), 2'-O-methylperlatolic acid (trace) and stictic acid (trace).

Substrate and Distribution—*Pertusaria platycarpa* is a rare, endemic corticolous species known only from the type specimen from Phu Lhuang Wildlife Sanctuary, Loei Province, in northeastern Thailand. It grows on *Acronychia* at 1470 m.

COMMENTS—*Pertusaria platycarpa* is characterised by asci with eight ascospores and the presence of lichexanthone and 2'-O-methylstenosporic acid. The new species is morphologically similar to *P. alboaspera* but that species contains stictic and 2,2'-di-O-methylstenosporic acids as a major compounds. The species resembles *P. praetermissa* A.W. Archer & Elix and *P. boweniana* A.W. Archer & Elix but those species contains 4,5-dichlorolichexanthone and 2-chlorolichexanthone respectively (Archer 1997) in place of lichexanthone present in the new species. The new species is chemically identical to *P. elixii* Jariangprasert but that species has four ascospores per ascus (Jariangprasert & Anusarnsunthorn 2005).

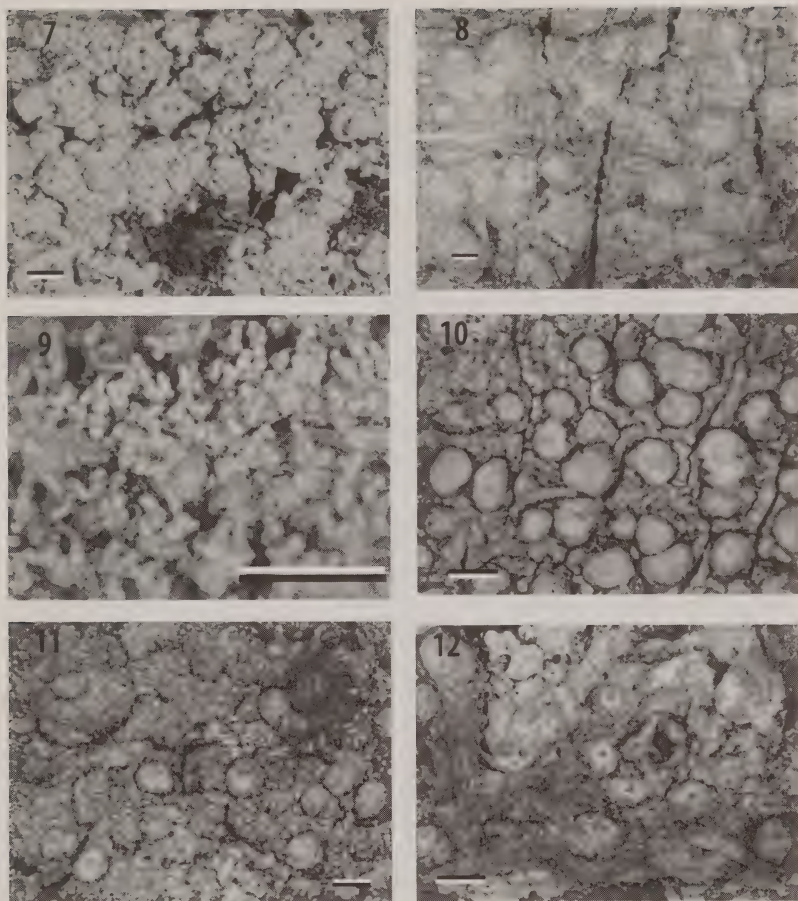
Pertusaria subcopelandii* Jariangprasert sp. nov.*Figure 11**

Similis *Pertusaria* *copelandii* *sed* *verrucis* *et* *ascosporis* *minoribus* *et* 4,5-dichlorolichexanthone *deficiens*.

Etymology: From the Latin *sub*, under or somewhat, a reference to the similarity with the species *Pertusaria copelandii*.

Holotype: THAILAND. Chiang Mai Province: Mae Rim District, The Queen Sirikit Botanic Garden, Doi Pha Glong Mountain, 1430 m, on bark of *Castanopsis ferox* in evergreen pine forest, *K. Boonpragob s.n.*, 7.xi.1994; holotype: RU 3087 (RAMK).

KEY CHARACTERS—**Thallus** corticolous, dark olive green, surface wrinkled, cracked, lacking isidia and soredia. **Apothecia** verruciform, conspicuous, concolourous with the thallus, flattened to concave, hemispherical to pseudolecanorine, very constricted at base, not confluent, 0.7-1.5 mm diam. **Ostioles** inconspicuous, in yellowish tissue, centrally depressed. **Ascospores** 2 per ascus, subfusiform to cylindrical, 100-170 μ m long, 30-50 μ m wide; smooth, outer ascospore wall 6-14 μ m thick.



Figures 7-12. New taxa of *Pertusaria* 7. *P. parameeana*, holotype (RAMK); 8. *P. phulhuangensis*, S. Jariangprasert 2192 (RAMK); 9. *P. pilosula* var. *abditiva*, S. Jariangprasert 3828 (QSBG); 10. *P. platycarpa*, holotype (QSBG); 11. *P. subcopelandii*, holotype (RAMK); 12. *P. subplanaica* var. *stictica*, S. Jariangprasert 2454 (RAMK). Scale bar = 1 mm.

Chemistry—K+ yellow, KC+ yellow, C-, Pd-, UV-; atranorin (minor), 2'-O-methylperlatolic acid (major), 2-O-methylperlatolic acid (minor), planaic acid (minor), methyl 2-O-methylperlatolate (minor), methyl planaiate (minor), stictic acid (major) and peristictic acid (trace).

Substrate and Distribution—*Pertusaria subcopelandii* is a rare, endemic corticolous species, known only from the type specimen from the Mae Rim District, Chiang Mai Province in northern Thailand. It grows on *Castanopsis* at 1430 m.

COMMENTS—*Pertusaria subcopelandii* is characterised by asci with two smooth ascospores and the presence of 2'-*O*-methylperlatolic and stictic acids. The new species resembles *P. copelandii* Vain. but lacks 4,5-dichlorolichexanthone and possesses smaller ascospores, 100-170 µm long compared to 163-200 µm in *P. copelandii*. The new species is chemically similar to *P. novaeguineae* but the latter has distinct black ostioles and asci with 3-4 ascospores (Archer & Elix 1998a).

***Pertusaria subplanaica* var. *stictica* Jariangprasert var. nov.**

Figure 12

Similis *Pertusaria subplanaica* sed *acidium sticticum continens differt*.

Etymology: the name of the new variety refers to the presence of stictic acid.

Holotype: THAILAND. Phitsanulok Province: Nakhon Thai District, Phu Hin Rong Kla National Park, by road from Mhun Daeng Waterfall at thirty-seventh kilometre stone, 1560 m, on bark of *Prunus cerasoides* in evergreen forest, S. Jariangprasert 2076, 19.i.2002; holotype: QSBG.

KEY CHARACTERS—**Thallus** corticolous, yellow ivory to greyish green, surface smooth, rarely wrinkled, lacking isidia and soredia. **Apothecia** verruciform, conspicuous, hemispherical, constricted at the base, not confluent, (0.5-)1.6-3.0 mm diam. **Ostioles** variable, inconspicuous to black and conspicuous, some sunken, surrounded with translucent tissue, 1-4 per apothecium. **Ascospores** (4-6)7-8 per ascus, uniseriate, occasionally basally biseriate, subfusiform to ellipsoid, 64-102 µm long, (27-)38-50 µm wide; smooth, outer ascospore wall 6-20 µm thick.

Chemistry—K+ pale to yellow, KC-, C-, Pd+ orange, UV+ orange; 4,5-dichlorolichexanthone (minor), 2,2'-di-*O*-methylstenosporic acid (major), 2,2'-di-*O*-methyldivaricic acid (major), 2'-*O*-methylstenosporic acid (minor), methyl 2'-*O*-methylstenosporate (minor), planic acid (minor) and stictic acid (major).

Substrate and Distribution—*Pertusaria subplanaica* var. *stictica* is a corticolous species found in northern and upper northeastern Thailand. It grows on *Castanopsis*, *Persea*, *Phyllanthus*, *Prunus* and *Syzygium* at altitudes between 100 and 1600 m.

COMMENTS—*Pertusaria subplanaica* var. *stictica* is characterised by asci with eight uniseriate ascospores and its chemistry. The new variety resembles *P. subplanaica* A.W. Archer & Elix var. *subplanaica* but is distinguished from that taxon by the presence of stictic acid (Archer 1997).

ADDITIONAL SPECIMENS EXAMINED—THAILAND. Chiang Mai Province: Jom Thong District, Doi Inthanon National Park, gateway to Ban Mae Glang Lhuang, 1040 m, on bark of *Syzygium aqueum* in deciduous forest, S. Jariangprasert 2394.1, 13.ii.2002 (QSBG); *ibid.*, on bark of *Castanopsis*, in deciduous forest, S. Jariangprasert 2454, 13.ii.2002 (QSBG). Phitsanulok Province: Nakhon Thai District, Phu Hin Rongkla National Park, opposite the headquarters, 1100 m, on bark of *Phyllanthus emblica* in pine plantation, S. Jariangprasert 1919.2, 19.i.2002 (QSBG). Loei Province: Phu Luang Wildlife Sanctuary, in front of the old palace, 1470 m, on bark of *Persea kurzii* in oak/chestnut forest, S. Jariangprasert 2171, 3.ii.2002 (QSBG); *ibid.*, close to Pha Chang Phan Cliff, 1510 m on unidentified bark (fragrant of tree), next to the cliff, in oak/chestnut forest, S. Jariangprasert 2249, 3.ii.2002 (QSBG).

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Two new *Cystoderma* species from high Andean Ecuador

IRJA SAAR¹ & THOMAS LÆSSØE²

irja.saar@ut.ee

¹*Institute of Botany and Ecology, University of Tartu
40 Lai St., Tartu, 51005, Estonia*

thomasl@bi.ku.dk

²*Department of Microbiology, National Institute, University of Copenhagen
Øster Farimagsgade 2D, Copenhagen K, DK-1353, Denmark*

Abstract—Two new agaric species, *Cystoderma andinum* and *C. papallactae* are described from high Andean Ecuador.

Key words—Agaricales, páramo

Introduction

The agaric genus *Cystoderma* Fayod (1889: 350–351) is known as widespread (Kirk et al. 2001). However, the majority of the approximately thirty known species are distributed in the temperate regions (Kirk et al. 2001, Smith & Singer 1945, Heinemann & Thoen 1973, Saar 2003). The tropical species described hitherto are *C. chocoanum* Franco-Mol., *C. cristalliferum* Thoen, *C. contusifolium* Pegler, *C. elegans* (Beeli) Thoen, *C. ferruginosum* (Bres.) Pegler, *C. luteohemisphaericum* Dennis and *C. siparianum* (Dennis) Thoen (Dennis 1961, Franco-Molano 1993, Pegler 1966, 1983, Thoen 1969). The majority of these species were described from lowland localities with a tropical climate, whilst *C. cristalliferum* and *C. elegans* both were collected from higher altitudes (1650 m) with a more temperate climate. Very few records of the genus *Cystoderma* have been published from South America and none from Ecuador. *Cystoderma siparianum* – a species described from Trinidad (Lesser Antilles), is possibly present in Ecuador since a specimen collected by Cronshaw, so named, is deposited in Kew. Dennis (1961, 1970) reported *C. amianthinum* (Scop.) Fayod and *C. luteohemisphaericum* from Andean and coastal Venezuela respectively. Pegler (1997) reported *C. amianthinum*, *C. contusifolium* and *C. siparianum* from São Paulo (Brazil), and described a new species *C. contusifolium* from Martinique, Lesser Antilles (Pegler 1983). Singer (1969) observed *C. amianthinum* from Argentina (Tierra del Fuego), Chile (Osorno, alt. 900 m) and Bolivia (La Paz, alt. 3000 m), and described a new species *C. austrofallax* Singer closely related to *C. fallax* A.H. Sm. & Singer from Chile (Valdivia, alt. 200 m). Franco-Molano (1993) described a new species *C. chocoanum* from Colombia (Chocó).

Three specimens of the genus *Cystoderma* collected by the second author and co-workers from high elevations in open páramo and *Polylepis* forest in Ecuador were studied and found to represent two undescribed species.

Methods

The colours of the basidiocarps were designated using the colour names by Kornerup & Wanscher (1974). Microscopic investigations were carried out using a Zeiss Axioskop 2 light microscope at magnification x1000 and measurements were made in 3% KOH solution. The pictures were adjusted with AxioVision 3.0 software (Carl Zeiss Vision GmbH). The spore measurements are based on 25 randomly taken basidiospores from each specimen. Colour photographs of the type specimens can be found at the homepage of the fungi of Ecuador (<http://www.mycokoey.com/Ecuador.html>).

Description of new species

Cystoderma andinum I. Saar & Laessøe, sp. nov.

FIGURES 1–4

MYCOBANK NUMBER MB 510024

Pileus 25–43 mm *latus*, *convexus vel umbonatus*; *superficies granuloso-squamulosa, primo testacea, deinde griseo-aurantiaca. Lamellae adnexae vel sinuate decurrente, integerrimae, albiae vel bubalinae. Stipes* 55–65 × 4–7 (–14) mm, *squamulosus; annulus evanescens. Sporae* (5.0–) 6.0–7.5 (–8.5) × (4.0–) 4.5–5.5 (–6.0) µm, *amyloideae, ellipsoideae. Basidia anguste clavata, 26–35 × 6–8 µm, 4-sterigmatibus. Cystidia desunt. Pileipellis catenis sphaerocystarum composita; arthrospora desunt. Hyphae fibulatae.*

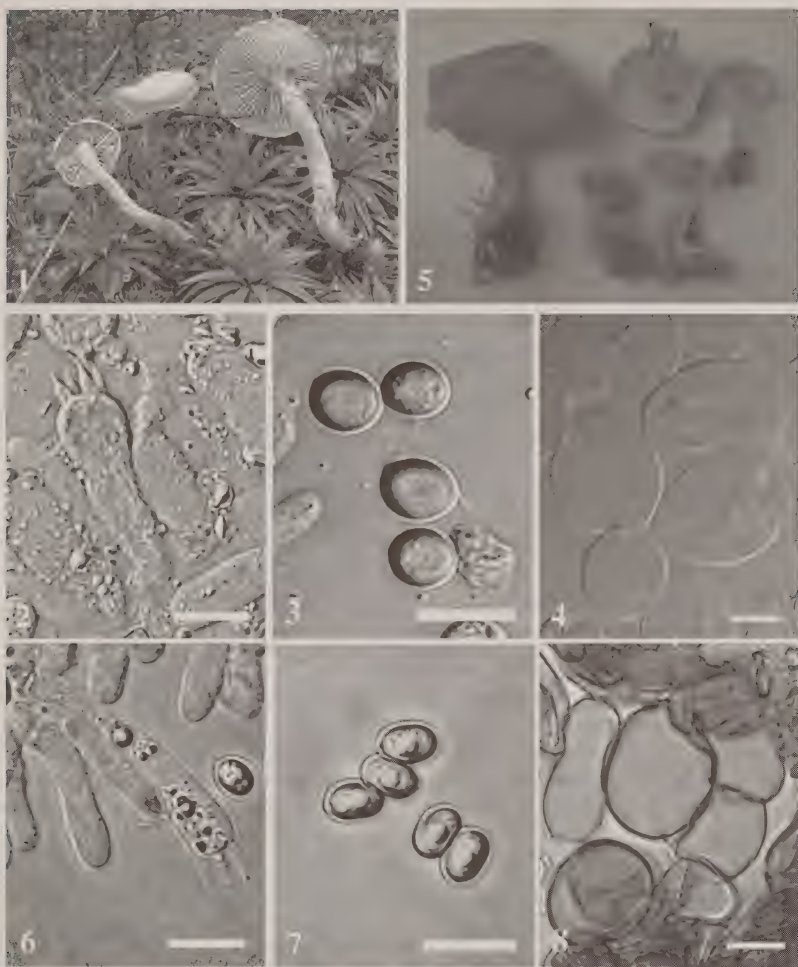
Holotypus: Ecuador, Napo, paramo El Virgen, ca. 3800 m alt., 7.IV. 2002, T. Laessøe (TL-9246) in herbarium QCA *conservatus est.*

Etymology: from the Andes

Pileus 25–43 mm, convex to slightly umbonate, dry, finely granulose-squamulose, margin appendiculate with white veil remnants, at first brick red (7D7 terra cotta, tile red) then fading greyish orange (5B5), retaining the darker colour at the margin for some time. **Lamellae** adnexed or sinuate with decurrent tooth, medium spaced, edge entire, whitish to cream (4A3) or somewhat darker. **Stipe** 55–65 × 4–7 (–14) mm, pale cream, turning a bit rusty brown in old specimens, densely squamulose below ring zone, with evanescent ring zone, base swollen or not, radicating in the plant cushion. **Context** white. **Odour** not distinctive or strongly of cyanide/unpleasantly earthy.

Basidiospores (5.0–) 6.0–7.5 (–8.5) × (4.0–) 4.5–5.5 (–6.0) µm, $Q = (1.1-) 1.2-1.6 (-1.8)$, broadly ellipsoid to ellipsoid, rarely oblong, hyaline, amyloid. **Basidia** narrowly clavate, hyaline, inamyloid, 4-spored, 26–35 × 6–8 µm. **Pleuro- and cheilocystidia** absent. **Pileipellis** formed by chains of sphaerocysts, 14–36 × 14–30 µm, globose to oblong, faintly rugulose, hyaline to yellowish brown in H₂O, not darkening in KOH; arthrospores absent. **Stipitipellis** composed of hyphae up to 7 µm broad, cylindric to inflated, covered by sphaerocysts 10–27 × 8.5–19 µm, similar to those forming the pileipellis. **Clamp connections** present.

Habitat in dense fascicle, among unidentified cushion plants in open páramo, in wet, cushion plant community.



Figs 1–8. *Cystoderma andinum* (C 57998, isotype): 1. Fruitbodies; 2. Basidia; 3. Spores; 4. Sphaerocysts from pileipellis. *Cystoderma papallactae* (C. 58002, isotype): 5. Fruitbodies; 6. Basidia; 7. Spores; 8. Sphaerocysts from pileipellis.
Bars = 10 μ m.

Collections examined – Ecuador, Prov. Napo, just below and E of the Papallacta pass, páramo El Virgen (00°19'66"S 78°12'06"W). Among unidentified cushion plants in open páramo. Alt.: ca. 3800 m, 7 April 2002, T. Læssøe TL-9246 (QCA, **holotype**; C 57998, **isotype**); Ibid., Vólcan Antisana, scrub along road leading W from Laguna Mica. In open wet, cushion plant community. Alt.: 3700 m., 22 June 2002, J. Salazar TL-9752 (QCA, C 58476).

Comments. This species belonging to section *Cystoderma* Singer (1962) is characterized by its large, strongly amyloid basidiospores. The temperate species having similarly coloured pilei, *C. granulosum* (Batsch) Fayod (brick red) and *C. adnatifolium* (Peck) Harmaja (greyish orange), have smaller ($4\text{--}5 \times 2\text{--}3\ \mu\text{m}$) and inamyloid basidiospores. Several species possessing pilei with different shades of brown and with amyloid basidiospores, described from tropical regions, differ likewise in having smaller spores: *C. austrofallax* ($4\text{--}5 \times 3\ \mu\text{m}$), *C. chocoanum* ($5.4\text{--}6.3 \times 2.7\text{--}3.6\ \mu\text{m}$), *C. cristalliferum* ($3.7\text{--}4.5 \times 2\text{--}3.2\ \mu\text{m}$) and *C. ferruginosum* ($4\text{--}5.2 \times 2\text{--}3.2\ \mu\text{m}$). *Cystoderma cristalliferum* furthermore has cheilo- and pleurocystidia.

The two collections are from the same region of Ecuador and from very similar plant communities.

***Cystoderma papallactae* I. Saar & Laessøe, sp. nov.**

FIGURES 5–8

MYCOBANK NUMBER MB 510025

Pileus 23–45 mm *latus*, *convexus vel umbonatus*; *superficies ruditer granuloso-squamulosa, testacea. Lamellae sinuate decurrente, integerrimae, albidae vel bubalinae. Stipes ad* $45 \times 6\text{ mm}$, *bulbosus, squamulosus; annulus evanescens. Sporae* $5.0\text{--}5.5\text{ (–}6.0\text{)} \times 3.0\text{--}3.5\text{ (–}4.0\text{)}\ \mu\text{m}$, *inamyloideae, ellipsoideae vel oblongae. Basidia clavata, 23–27* $\times 6\ \mu\text{m}$, *4-sterigmatibus. Cystidia desunt. Pileipellis catenis sphaerocystarum composita; arthrospora desunt. Hyphae fibulatae.*

Holotypus: Ecuador, Napo, paramo El Virgen, ca. 3800 m alt., 7.IV.2002, T. Læssøe (TL-9250) in herbarium QCA *conservatus est*,

Etymology: locality Papallacta, Ecuadorean Andes

Pileus 23–45 mm, convex to faintly umbonate, coarsely granulate-squamulose, margin hardly appendiculate, brownish orange (7C7) or brick red (terra cotta, tile red 7D7), fading in age. **Lamellae** sinuate, with decurrent tooth, medium spaced, edge entire, white to cream (4A3). **Stipe** up to $45 \times 6\text{ mm}$, at base 10 mm, orange brown, squamulose below ring zone, with evanescent ring zone, base white, bulbous. **Context** white to cream. **Odour** faint, slightly metallic when cut. **Taste** indistinct, like raw cucumber and astringent.

Basidiospores $5.0\text{--}5.5\text{ (–}6.0\text{)} \times 3.0\text{--}3.5\text{ (–}4.0\text{)}\ \mu\text{m}$, $Q = (1.4\text{--})\ 1.4\text{--}1.8$, ellipsoid to oblong, hyaline, inamyloid. **Basidia** clavate to narrowly clavate, hyaline, inamyloid, 4-spored, $23\text{--}27 \times 6\ \mu\text{m}$. **Pleuro-** and **cheilocystidia** absent. **Pileipellis** formed by chains of sphaerocysts, $18\text{--}37 \times 15\text{--}27\ \mu\text{m}$, subglobose to oblong, faintly rugulose, pale yellowish brown to cinnamon in H_2O , not darkening in KOH; arthrospores absent. **Stipitipellis** composed of hyphae up to $8\ \mu\text{m}$ broad, cylindric to inflated, covered by sphaerocysts $19\text{--}39 \times 13.5\text{--}30\ \mu\text{m}$, similar to those forming the pileipellis. **Clamp connections** present.

Habitat in moss under *Polylepis* tree.

Collections examined – Ecuador, Prov. Napo, just below and E of the Papallacta pass, páramo El Virgen ($00^\circ 19' 66''\text{S } 78^\circ 12' 06''\text{W}$). In moss under big *Polylepis* tree. Alt.: ca. 3800 m, 7 April 2002, leg. T. Læssøe TL-9250 (QCA, **holotype**; C 58002, **isotype**).

Comments. This species belongs to section *Granulosa* (Fr.) Locq. emend Locq. (1951; see also Singer 1986), or if a narrow generic system is adopted in the genus *Cystodermella* Harmaja (2002). It is characterized by its large inamyloid basidiospores and brownish

orange pileus. The temperate species, *C. granulorum* with similarly coloured pileus, has smaller ($4\text{--}4.5 \times 2.5\text{--}3 \mu\text{m}$) basidiospores. The other species with brown-coloured pilei, discussed under *C. andinum*, have amyloid basidiospores.

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Glomerospores: a new denomination for the spores of Glomeromycota, a group molecularly distinct from the Zygomycota

BRUNO TOMIO GOTO & LEONOR COSTA MAIA

brunogoto@hotmail.com leonorcmaia@yahoo.com.br

Programa de Pós-Graduação em Biologia de Fungos,

Departamento de Micologia, Universidade Federal de Pernambuco

Av. Prof. Nelson Chaves s/n, Cidade Universitária, 50670-420, Recife, PE, Brazil

Abstract—The arbuscular mycorrhizal fungi (AMF) are grouped into the Glomeromycota phylum. However, the names used for the spores formed by these fungi are not clear, being based on morphological characters, some of which can be shared by fungi in separate phyla (Glomeromycota and Zygomycota – *Endogonales*), due to adaptative convergence. Considering also that all other phyla of fungi have their own characteristic spore types, with unique names, we propose a denomination to be used only for the spores of Glomeromycota.

Key Words—Glomeromycetes, mycorrhiza, taxonomy, terminology

Taxonomy

The terminology used for the spores of arbuscular mycorrhizal fungi (AMF) has changed according to each author's view, and different names such as chlamydospores, conidia, sporophores, azygospores or even simply spores have been used to describe these propagative structures (Gerdemann & Trappe 1974, Gibson 1985, Walker & Sanders 1986, Walker 1987, Morton 1988, Schenck & Pérez 1990, Tommerup & Sivasithamparan 1990).

Nowadays the AMF, earlier included in *Glomales*, an order of Zygomycetes (Morton & Benny 1990), are separated from the Zygomycota based on molecular studies. Schüssler et al. (2001) proposed the phylum Glomeromycota and indicated that these fungi are more closely related to Ascomycota and Basidiomycota than to Zygomycetes. This proposal has been accepted (Tehler et al. 2003), although for some it is premature to recognize the glomalean fungi as a phylum (Tanabe et al. 2005). Anyway, each fungal phylum has an appropriate name for its spores: ascospore for Ascomycota, basidiospore for Basidiomycota, zygospore for Zygomycota (Gerdemann & Trappe 1974, Alexopoulos et al. 1996). All of these are formed by sexual reproduction, while in Glomeromycota there is no evidence of a sexual process. On the other hand, asexual spores have different denominations, based on formation and similarity with spores of other groups.

Considering that in Glomeromycota the reproductive structures are apparently of asexual origin, there is no agreement among authors in regard to the nature of these spores (Morton 1988). The term chlamydospore, for example, was designated for the resistant spores of other species (Gerdemann & Trappe 1974). In *Acaulospora*, *Entrophospora* and *Gigaspora* the spores have been named azygospores, due to the similarity of the vesicle in the first two genera and the suspensor in the third, with the azygospores formed parthenogenetically in some Zygomycetes, a group in which the AMF were included.

This terminology is confused because within a phyletic group (Morton & Benny 1990, Schüssler et al. 2001), with reproduction exclusively asexual, the spores present diverse nature. This is not uncommon among other groups of asexual fungi such as the "Deuteromycetes", that form chlamydospores, blastospores, arthrospores and conidia (Alexopoulos et al. 1996).

Endogone Link contains fungi morphologically similar to the Glomeromycota, but its spores (zygospores), produced in sporocarps, have sexual origin (Alexopoulos et al. 1996), while azygospores are rarely observed (Berch & Fortin 1983). During zygospore formation, two walls are distinguished: an outer wall, from the zygosporangium, and an inner wall, from the zygospore (O'Donnell et al. 1978a, b). In the AMF, the spore presents a single unique wall (Maia & Kimbrough 1993) formed by many layers of different appearance (Walker 1983).

Germination of spores in *Endogonales* is similar to that of Glomeromycetes (*Acaulospora*, *Entrophospora*, *Scutellospora* and *Pacispora*), with the germ tube emerging either from a germinal shield, directly through the spore wall or from the hyphal insertion point (O'Donnell 1978a, b).

The germinal shield of AMF is highly specialized, being helicoid (*Scutellospora projecturata* Kramad. & C. Walker) or rich in foldings (*Entrophospora colombiana* Spain & N.C. Schenck, *Acaulospora tuberculata* Janos & Trappe, *A. rehmsii* Sieverd. & S. Toro, *S. gilmorei* (Trappe & Gerd.) C. Walker & F.E. Sanders, *S. scutata* C. Walker & Dieder., *S. cerradensis* Spain & J. Miranda). Spores of *Endogone pisiformis* Link have a germinal shield less elaborated than that of the AMF, formed between the endospore wall (zygospore) and the exospore wall (zygosporangium) and although each spore can have up to three germinal shields, only one will originate the germinal tube.

On the other hand, spores of AMF produce a germinal shield in various places in the outer or innermost layers of the so-called "germinal wall". Berch & Fortin (1983) mentioned that spores of AMF and *Endogone* present such characteristics by adaptative convergence, since in both cases the thick spore wall provides higher resistance to environmental stresses such as predation and action of soil microorganisms. Molecular data (Schüssler et al. 2001) seem to confirm this hypothesis of adaptative convergence, since the AMF form a homogeneous group separated from the Zygomycetes.

Chlamydospores are resistant spores, with a thick wall (Kirk et al. 2001). Based on molecular data (Schüssler et al. 2001) that show a monophyletic group, and also on the morphological diversity of the complex sub cellular structure of the AMF spore wall, unique in the Regnum Fungi, we propose the name glomerospores for the spores of Glomeromycota. This would distinguish these spores from those of other different taxa.

Glomerospores – Asexual reproductive structures formed at the end of a subtending hypha, or a bulbous sporogenous cell, or from a sporiferous saccule, in this case with lateral or intercalary position, with or without a germinative component, presenting or not a germinal shield or orb, typically formed by fungi that form an arbuscular mutualistic symbiosis with most terrestrial plants.

Etymology: “Glomero” = referring to the Glomeromycota phylum + “spore” = reproductive structure.

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The sequestrate genus *Rhodactina* (Basidiomycota, *Boletales*) in northern Thailand

ZHU L. YANG¹, JAMES M. TRAPPE², MANFRED BINDER³,
RARUNEE SANMEE⁴, PIPOB LUMYONG⁵ & SAISAMORN LUMYONG⁶

fungi@mail.kib.ac.cn

¹Laboratory of Biodiversity and Biogeography, Kunming Institute of Botany
Chinese Academy of Sciences, Kunming 650204, Yunnan, China

trappej@onid.orst.edu

²Department of Forest Science, Oregon State University
Corvallis, Oregon 97331-5752, USA

mbinder@clarku.edu

³Biology Department, Clark University, Lasry Building for Bioscience
950 Main St., Worcester, Massachusetts 01610-1477, USA

rarunee_s@advanceagro.com

⁴Department of Biology, Faculty of Science, Chiang Mai University
Chiang Mai 50200, Thailand

agppi003@chiangmai.ac.th

⁵Department of Plant Pathology, Faculty of Agriculture, Chiang Mai University
Chiang Mai 50200, Thailand

scboi009@chiangmai.ac.th

⁶Department of Biology, Faculty of Science, Chiang Mai University
Chiang Mai 50200, Thailand

Abstract—The sequestrate *Rhodactina* was originally proposed as a monotypic genus to accommodate *R. himalayensis* and was suggested be a member of the *Gautieriaceae* because of similarities in spore ornamentation. Our results, based on *atp6* sequences, however, place *Rhodactina* in the *Boletaceae*. In addition to the type species, a new species, *R. incarnata*, from northern Thailand is described and illustrated.

Key words—taxonomy, new taxon, phylogeny, mycorrhizae, distribution

Introduction

Fungi in northern Thailand have not been intensively studied, but many macrofungi have been collected from the region in recent years. Among them are two species of *Rhodactina* Pegler & T.W.K. Young (1989)—*R. himalayensis* and *R. incarnata*— which we describe here. The phylogenetic position of this unusual genus was inferred from a nucleotide tree based on *atp6* sequences.

Materials and methods

Collecting and taxonomic procedures

Mature and developing basidiomata of *Rhodactina* were collected in forests dominated by *Dipterocarpaceae* in northern Thailand. The possible mycorrhizal hosts were recorded at the time of collecting. Specimens were annotated and/or photographed in the field. Colour standards used were Ridgway (1912), and Kornerup and Wanscher (1981). Colour names with first letters capitalized, e.g. "Light Corinthian Red", are from Ridgway (1912); colour codes of the form "8A2" indicate the plate, row, and colour block in Kornerup and Wanscher (1981). Specimens were dried in an electric drier, and then deposited in herbaria. Herbarium abbreviations follow Holmgren et al. (1990).

Tissues were mounted in 3% KOH, Melzer's reagent, and cotton blue for microscopic examination. Q refers to the length/width ratio of basidiospores; $\bar{Q}$ refers to the average Q of all basidiospores $\pm$ sample standard deviation.

Molecular procedures

The mitochondrial *atp6* gene, which codes for ATPase subunit 6, was amplified using the primer combination ATP6-1 and ATP6-2 (Kretzer and Bruns 1999). The reaction conditions and cycling protocols are described in detail by Kretzer and Bruns (1999). Dr. Martin Bidartondo (Royal Botanical Gardens Kew) kindly provided the *atp6* sequence for the holotype of *R. incarnata* CMU 25116 (GenBank accession DQ328982). Collections of *R. himalayensis* were largely infected by parasitic *Sepedonium* spp. and were not used for molecular studies. All PCR products were sequenced by use of BigDye terminator sequencing chemistry (Applied Biosystems, Foster City, California), purified with Pellet Paint (Novagen, EMB Biosciences, San Diego, California), and run on an Applied Biosystems 3730 capillary DNA sequencer. The newly generated sequencing data were aligned by codon in the editor of PAUP* 4.0b10 (Swofford, 2002). The final data set consisted of 49 species using 32 sequences drawn from the study of Kretzer and Bruns (1999), eight sequences downloaded from the AFTOL database (<http://ocid.nacse.org/research/aftol/>), four sequences from Binder & Hibbett (unpublished), and four unpublished sequences provided by Z. Wang.

The *atp6* nucleotide data set was analyzed by maximum likelihood approaches and Bayesian MCMC. The general time reversible model with distribution of rates at variable sites modeled on a discrete gamma distribution with four rate classes (GTR+G) was estimated with MODELTEST 3.06 (Posada and Crandall 2001) as best-fit likelihood model. Two parallel Bayesian analyses were performed with MrBayes v3.1.1 (Ronquist & Huelsenbeck, 2003) with four chains and 5×10^6 generations each, saving trees every 1000th generation. Posterior probabilities for the Bayesian approach were determined by calculating a 50% majority rule consensus tree with the proportion of trees gathered after convergence of likelihood scores was reached.

The *atp6* data were analyzed in PAUP* by maximum likelihood under the GTR+G model with nucleotide frequencies estimated (A=0.3450, C=0.1010, G=0.0839, T=0.470), a rate matrix of substitutions (A-C=1.2850, A-G=3.4710, A-T=1.8277, C-G=4.1821, C-T=3.4710, G-T=1.0000), and $\alpha = 0.3771$. In addition, a likelihood bootstrap analysis

was performed under the same settings using 1000 replicates with MAXTREES set to 1000. All analyses were run on a Linux Pro 9.2 Opteron AMD 246 cluster (Microway).

Taxonomy

1. *Rhodactina incarnata* Zhu L. Yang, Trappe & Lumyong, sp. nov.

Figs. 1-2

Basidiomata 1.5-3 cm lata. *Peridium*que gleba incarnata. *Basidiosporae* pallide purpureae vel incarnatae, dextrinoideae, $10-13 \times 10-12 \mu\text{m}$ ornamentum porcae 8-10 acutium longitudinalium includentes. *Basidia* $28-40 \times 8-10 \mu\text{m}$, 4-sporigera. *Cystidia* nulla. *Fibulae* absentes.

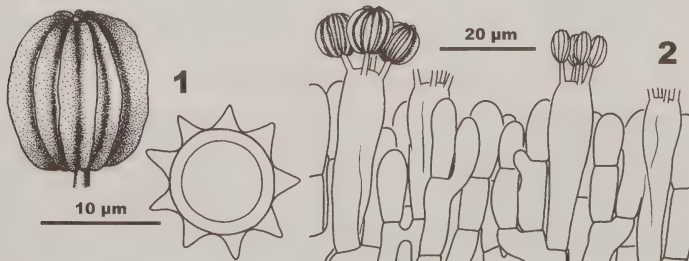
Etymology: Latin *incarnata*, “flesh coloured”, referring to the colour of the basidioma.

Basidiomata 1.5-3 cm diam., subglobose to ovoid, with a rudimentary basal attachment. **Peridium** 0.5-1 mm thick, pale pink (Light Corinthian Red to Testaceous, 8A2-4), glabrous and smooth. **Gleba** completely enclosed, pink (Corinthian Red to Rose Doree, 10A4-6), viscid, irregularly to angularly loculate; loculi 0.5 to 1.5 mm broad. **Stipe-columella** absent.

Basidiospores including ornamentation $10-13 \times 10-12 \mu\text{m}$, $Q = 1-1.1$, $Q = 1.03 \pm 0.04$, excluding ornamentation $9.5-12 \times 7-8 \mu\text{m}$, $Q = 1.3-1.5$, $Q = 1.38 \pm 0.07$, statismosporic, orthotropic, broadly ellipsoid to subfusiform excluding ornamentation, purplish, purplish red to carneous, with a strongly dextrinoid wall ca. $1 \mu\text{m}$ thick; ornamentation of 8-10 solid ridges regularly and longitudinally arranged, up to $3 \mu\text{m}$ tall and 2-3 μm wide at the base, giving the spores a stellate appearance in polar-view; sterigmal appendage short, nearly truncate. **Basidia** $28-40 \times 8-10 \mu\text{m}$, clavate to subcylindric, (1-) 4-spored; sterigmata stout, straight, up to $5 \mu\text{m}$ long. **Cystidia** lacking.

Tramal plates 80-200 μm thick, with a narrow, central layer of subparallel to loosely interwoven hyphae $1.5-7 \mu\text{m}$ broad, hyaline, thin-walled, non-gelatinized to gelatinized. **Peridiopellis** poorly differentiated, of interwoven, thin-walled hyphae 2-8 μm broad that are covered with brown encrustations. **Clamp connections** lacking.

Habit, habitat, distribution and season—Subepigeal, on sandy soil under leaf litter in a dry forest dominated by *Dipterocarpaceae*; known only from the type locality in northern Thailand (Chiang Mai); July.



Figs. 1-2: *Rhodactina incarnata* (holotype). 1. Basidiospores in equatorial view (left) and in polar-view (right); 2. Hymenium with basidia at different stages of development.

COLLECTION EXAMINED—THAILAND, CHIANG MAI, SANPATONG DISTRICT, Mae Wang, Conservation Forest, Sanpatong-Ban Guard Rd., 24.VII.2002, S. Lumyong, P. Lumyong, R. Sanmee & Z. L. Yang 45209 (**HOLOTYPE** CMU 25116, isotype OSC).

Comments—*Rhodactina incarnata* is characterized by its broadly ellipsoid to subfusiform basidiospores $9.5\text{--}12 \times 7\text{--}8 \mu\text{m}$ (excluding ornamentation) that are purplish, purplish red to carneous and ornamented with 8-10 longitudinal ridges, and basidia $28\text{--}40 \times 8\text{--}10 \mu\text{m}$. *R. himalayensis* differs in having fusiform to subfusiform basidiospores $12\text{--}16 \times 7.5\text{--}9.5 \mu\text{m}$ (excluding ornamentation) with (5) 6-7 (8) ridges and basidia $40\text{--}68 \times 12\text{--}15 \mu\text{m}$ (see below; Pegler and Young 1989; Table 1). The two species are easily differentiated: none of these characters overlap except spore color, which tends to be more red in *R. incarnata* than *R. himalayensis*.

Table 1. Distinguishing characteristics of *R. himalayensis* and *R. incarnata*

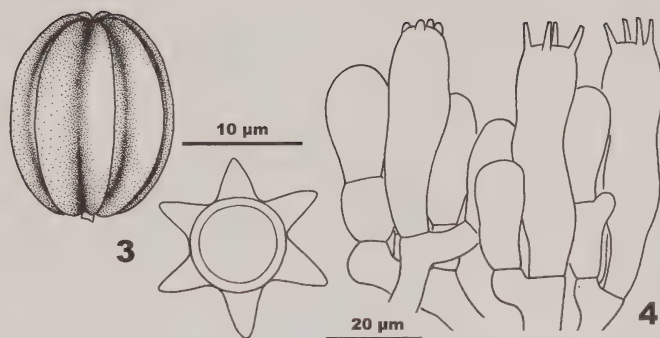
Character	<i>R. himalayensis</i>		<i>R. incarnata</i>
	Data of Yang et al.	Data of Pegler & Young	Data of Yang et al.
Size of spores with ornamentation	$15\text{--}20 \times 12.5\text{--}18 \mu\text{m}$, Q = 1.1-1.2	$16\text{--}20 \times 13\text{--}17.5 \mu\text{m}$, Q = 1-1.3	$10\text{--}13 \times 10\text{--}12 \mu\text{m}$, Q = 1-1.1
Size of spores without ornamentation	$12\text{--}16 \times 7.5\text{--}9.5 \mu\text{m}$, Q = 1.5-1.8	$11\text{--}16 \times 7\text{--}10 \mu\text{m}$, Q = 1.5	$9.5\text{--}12 \times 7\text{--}8 \mu\text{m}$, Q = 1.3-1.5
Number of ridges on spores	(5) 6-7 (8)	(5) 6-7 (8)	8-10
Height and width of ridges on spores	3-4 μm wide, up to 5 μm tall	2.5-4.5 μm wide	2-3 μm wide, up to 3 μm tall
Size of basidia	$40\text{--}68 \times 12\text{--}15 \mu\text{m}$	$30\text{--}50 \times 9\text{--}12 \mu\text{m}$	$28\text{--}40 \times 8\text{--}10 \mu\text{m}$

2. *Rhodactina himalayensis* Pegler & T.K.W. Young, Opera Bot. 100: 201, 1989.

Figs. 3-4

Basidiomata 2-3 cm broad, subglobose to short-pyriform, with an indistinct basal attachment. **Peridium** 0.5-1 mm thick, pale purple to pale violaceous, becoming dirty white to grayish when dried, glabrous. **Gleba** completely enclosed, violet brown to purple-brown when mature, purplish dark brown when dried, irregularly to angularly loculate; locules up to 1.5 mm broad. **Stipe-columnella** absent.

Basidiospores including ornamentation $15\text{--}20 \times 12.5\text{--}18 \mu\text{m}$, Q = 1.1-1.2, Q = 1.12 ± 0.04 , excluding ornamentation $12\text{--}16 \times 7.5\text{--}9.5 \mu\text{m}$, Q = 1.5-1.8, Q = 1.62 ± 0.11 , statismosporic, orthotropic, fusiform to subfusiform excluding ornamentation, purple to purplish, with a strongly dextrinoid wall up to 1 μm thick; *ornamentation* of (5) 6-7 (8) solid, regularly and longitudinally arranged ridges up to 5 μm tall and 3-4 μm wide, giving the spores a stellate appearance in polar-view; *sterigmatal appendage* short, nearly truncate. **Basidia** $40\text{--}68 \times 12\text{--}15 \mu\text{m}$, clavate to subcylindric, 4-spored; sterigmata straight, up to 5 μm long. **Cystidia** lacking.



Figs. 3-4: *Rhodactina himalayensis* (CMU 25117). 3. Basidiospores in equatorial view and polar-view; 4. Hymenium with basidia at different stages of development.

Tramal plates 70-250 µm thick, with a narrow, central layer of subparallel to loosely woven hyphae 1.5-10 µm broad, hyaline, thin-walled, non-gelatinized to gelatinized. **Peridiopellis** appressed, poorly differentiated, of interwoven, thin-walled hyphae 2-8 µm broad that are covered with brown encrustations. **Clamp connections** lacking.

Habit, habitat, distribution and season—subepigeal, associated with *Dipterocarpaceae*; known from northwestern India (Uttar Pradesh) and northern Thailand (Chiang Mai); January-November.

COLLECTION EXAMINED—THAILAND, CHIANG MAI, Doi Suthep-Pui National Park, forest behind Channel 9 TV Station, 4.VIII.2000, S. Lumyong, P. Lumyong, R. Sanmee & B. Dell 2254 (CMU 25117, OSC).

Comments—Originally described from northwestern India, *Rhodactina himalayensis* is characterized by basidiospores with (5)6-7(8) longitudinally arranged ridges. Pegler and Young (1989) described its peridial surface “whitish with a pale drab grey tinge, soon bruising brownish grey to blackish brown.” They did not examine fresh specimens, however, so those colors were likely noted by the original collector from faded specimens. The fresh peridial surface of our collections was pale purple to pale violaceous but became dirty white to grayish when dried.

Results of *atp6* analysis

The final alignment of the *atp6* data set included 705 positions. The optimal tree inferred under the maximum likelihood criterion (Fig. 5) had a likelihood of -9856.89. For comparison, the best states of the cold chain were -9880.67 and -9880.99 in the two parallel Bayesian runs, respectively. Bayesian runs converged to stable likelihood values after 150,000 generations, and 4850 trees from each individual run were combined to calculate posterior probabilities. The average standard deviation of split frequencies was 0.002836 at the end of the runs. Bayesian posterior probabilities (BPP) strongly support most internodes in the *Boletales* with values of 1.0, while bootstrap values (BS) are

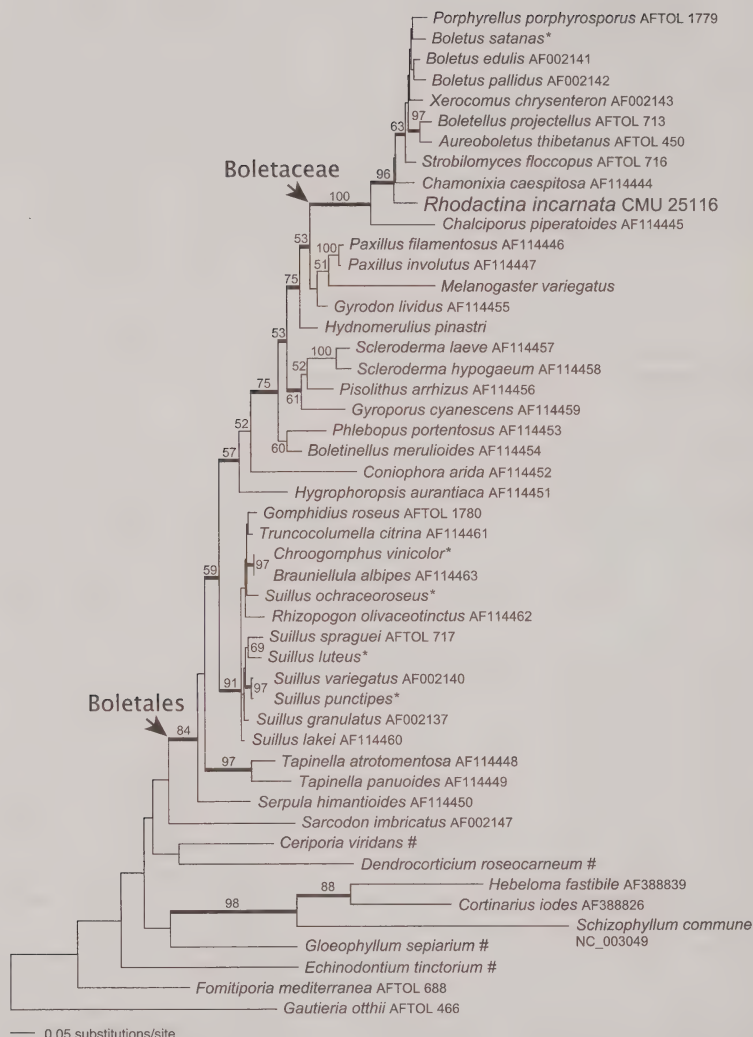


Fig. 5: Phylogenetic placement of *Rhodactina incarnata* inferred from *atp6* sequences. Branches in boldface indicate Bayesian posterior probabilities of 1.0, lower support values are not shown. Bootstrap support values (in %) are provided at internodes. Published sequences are either flagged with GenBank accession numbers or AFTOL numbers. Sequences marked with an asterisk are available from the Bruns laboratory web site (<http://plantbio.berkeley.edu/~bruns/>). Sequences that are highlighted with pound signs are by courtesy of Zheng Wang (University of Iowa).

generally lower (52 – 100%). The placement of *Rhodactina incarnata* in the *Boletaceae* is strongly supported by both methods (BPP = 1.0, BS = 100%).

Discussion

The study of origins of gasteromycetes and their diversity has been a subject of major interest to fungal taxonomists and molecular systematists. Convergent evolution of morphological characters becomes an increasingly emerging pattern when recent phylogenies are compared to classical concepts. Hosaka et al. (in press) have shown that a spore ornamentation of longitudinal ridges cuts across orders: the genus *Austrogautieria*, thought because of spore ornamentation to belong to the *Gomphales* along with *Gautieria*, turns out from molecular data instead to belong to the *Hysterangiales*. Pegler and Young (1989) originally placed *Rhodactina* in the *Gautieriaceae* because of the resemblance of its spore ornamentation to *Gautieria* and *Austrogautieria*. They did acknowledge that *Rhodactina* might be in the *Boletales*, because one of the paratypes of *R. himalayensis* was infected by *Sepedonium chrysospermum* (Bull.) Fr., a parasite of boletes. In addition, the ultrastructure of the ornamentation of *R. himalayensis* spores closely resembles that of *Chamonixia*, another gasteroid genus in the *Boletales* (Kretzer and Bruns 1999; Binder and Bresinsky 2002) that produces statismospores with longitudinal costae. Our results inferred from analyses of mitochondrial *atp6* gene sequences unambiguously place *R. incarnata* in the *Boletaceae*. Nevertheless, its closest relatives were not resolved in this study, mainly because of the limited availability *atp6* sequences for *Boletaceae*. Apparently, *R. incarnata* is not closely related to *Chamonixia*. Minute amounts of genomic DNA did not allow us to amplify additional loci, such as the nuclear ribosomal large subunit or the internal transcribed spacer region, which will be instrumental to place *Rhodactina* species more accurately in future studies.

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The Skibotn area in North Norway – an example of very high lichen species richness far to the north

ARVE ELVEBAKK^{1*} & JARLE W. BJERKE^{2*}

¹*arve.elvebakk@ib.uit.no*, ²*jarle.bjerke@ib.uit.no**

Department of Biology, University of Tromsø
Tromsø N-9037, Norway

Abstract—During the 4-day excursion of the Nordic Lichen Society (NLF) in 2003, 653 lichen species were recorded from the Skibotn area in eastern Troms County, central North Norway, bringing the total of known lichen species from the area to 709. Of the 291 species considered rare, 250 were found during the excursion. Of the 115 species reported as new to Troms County, 29 are also new to North Norway and eight new to Norway. Two species, *Caloplaca spitsbergensis* and *Stereocaulon groenlandicum*, are new to Fennoscandia. The number of lichenicolous species increases to 803 for the region when 94 previously known species are added. We believe that only Sweden's Torneträsk region surpasses this diversity. The high species number—remarkable for such northern latitudes (68–69° N)—challenges the general concept that species richness decreases as latitude increases. A fully annotated checklist of the Skibotn species is now posted on <http://www.mycotaxon.com/resources/weblists.html>

Keywords—lichenology, local flora, new records, Arctic fringe, biodiversity

Introduction

The Skibotn area, North Norway, has been much used for excursions and field courses after the University of Tromsø established a field station there. The vascular plant and bryophyte floras of the area are very rich (Engelskjøn et al. 1995, Elvebakk unpubl.), and an international mycological congress reported 818 species from this and adjacent areas (Mathiassen et al. 1995). The NLF (Nordisk Lichenologisk Förening/Nordic Lichen Society) excursion in August 2003 represents the first recent professional study of the area's lichen mycota.

Skibotn/Ivgobahta is situated at the outlet of the Skibotndalen/Ivgovuovdi valley, which runs in a northwest to southeast direction from the Lyngen fjord almost to the Finnish border near Kilpisjärvi. The lower valley belongs to the middle boreal zone and has a continental climate with a mean July temperature of 13.5° C (for 1961–1990) and an annual precipitation of 475 mm (for 1984–1990 at the Skibotn meteorological station) (Aune 1993). The valley experiences a pronounced local rain-shadow effect as shown by the precipitation values for Kvesmenes/Vieksegieddi (630 mm) and Oteren/Čavkkus (970 mm), two villages lying only 15–20 km to the southwest. Three bedrock patterns occur in the valley: acidic arkosic schists near the fjord, calcareous schists and marble in the central valley, and acidic schists and other rock types toward the east. The mountain areas have strongly contrasting bedrock geology.

During the 2003 NLF meeting at Skibotn, 38 participants visited eight different localities within Storfjord and the county of Troms: sea shore rocks, south-facing rock walls, boulder slopes and forests in the warmer valley bottom, river gorge with well-developed rocky inundation zone, and diverse habitats in low (600 m) and middle (1150 m) alpine belts. Calcareous and non-calcareous substrates were present at all collecting sites except for the seashores. A annotated, complete list of all species recorded can be downloaded from <http://www.mycotaxon.com/resources/weblists.html>. Both Table 1 and the fully annotated checklist were compiled using specimen-based data supplied by the excursion participants from collections housed in home institutions or personal herbaria.

Results

Some findings from the excursion have already been published as species new to Troms by Jørgensen (2004), Westberg et al. (2004) and Santesson et al. (2004). We list another 115 species new to Troms county in Table 1. We follow the nomenclature set forth by Santesson et al. (2004) and cite author names only for those species not treated (or cited with another name) by those authors.

During the excursion, 653 lichen species were recorded from the Skibotndalen area. When this number is added to the 26 species previously reported from the area and another 30 species slightly further to the south, the total for the region of known lichen species comes to 709. Of the 291 species considered rare, 250 were found during the excursion. Rare species were found in all localities visited. Seashore rocks housed both rare northern (*Caloplaca fraudans*, *C. spitsbergensis*, *Lecanora atosulphurea*, *Verrucaria halophiloides*) and rare southern species (*Lecanora andrewii*, *Verrucaria praetermissa*). Rocky valley slopes hosted known thermophilous lichen mycota (*Degelia plumbea*, *Pannaria conoplea*, *Melanelia subargentifera*, *Xanthoparmelia conspersa*) supplied by *Leptochidium albociliatum*, *Melanelia tominii*, *Psorula rufonigra*, *Spilonema revertens* and *Squamarina degelii*. The valley river gorge had a richly developed inundation zone with rocks with many rare species (*Aspicilia aquatica*, *A. supertegens*, *Caloplaca atosulphurea*, *C. diphyodes*, *Ephebe hispidula*, *E. lanata*, *Hymenelia arctica*, *Miriquidica plumbeoatra*, *Placynthium flabellousum*, *P. rosulans*, *Porpidia ochrolemma*, *Rhizocarpon amphibium*, *Verrucaria latebrosa*).

Rare species of the mountains—*Carbonea atronivea*, *Calvitimela perlata*, *Lecania subfuscula*, *Lecanora flotowiana*, *Leciophysma furfurascens*, *Polysporina ferruginea*, *Stereocaulon arenarium*, *S. groenlandicum*, *Umbilicaria dendrophora* and *Vulpicida tubulosus*—include a placodioid species still not determined to genus level.

Discussion

Species richness and diversity

The general trend in biodiversity is that species richness decreases with increasing latitudes (e.g. Barthlott et al. 1996). Thus, it is remarkable that a local lichen mycota has more than 700 species as far north as 69° 20' N. This even more impressive when we include another 94 fully identified lichenicolous fungi (Alstrup et al., in prep.), bringing the total of known lichenized and lichenicolous fungal species to 807.

Measuring biodiversity according to region is not easy. One alternative is to use

an existing database. By consulting the impressive internet-based Norwegian Lichen Database (NLD), we can generate a grid-based measurement of known lichen species diversity that closely reflects collecting activity. A February, 2005, NLD search of a few well-studied municipalities showed Oslo with 767 taxa, Granvin (the home municipality of J. J. Havaas) with 641, Storfjord (data processed until then) with 607, Trondheim and Oppdal both with 589, and Tromsø with 568.

Municipalities of course have different sizes, and the NLD database is still incomplete. For instance the NLD lists only 396 species for Vega. Yet, Degelius (1982) reported no fewer than 668 lichen species from this municipality, a number that in 1981 a large Norwegian newspaper cited as a world record among local lichen mycotas (!). Degelius (1982) himself described the lichen mycota in the region as “one of the richest in the world”.

The NLF excursions provide interesting insights into lichen diversity. The potentially most interesting localities within each region were intensively studied during 4-5 days by 21 to 55 participants, always including very skilled field lichenologists. Species lists are available for the 1985-1997 excursions. The proportion of lichenicolous fungi has increased over the years and has never been as high as for 2003. If purely literature reports, lichenicolous fungi and uncertain lichen determinations are omitted, there is an interesting north-south gradient, with the southernmost 1987 Bornholm excursion (Hansen 1987) having the lowest species number (282) and the present northernmost one with the highest (657). The four central Scandinavian excursions— Åsele Lappmark in 1991 (Thor 1992), central Norway in 1985 (Øvstedal 1986), southern Finland in 1989 (Vitikainen 1991) and Nord-Trøndelag in 1993 (Holien et al. 1994) — are intermediate (with 549, 447, 428 and 398 species, respectively). When plotted against latitudes, these results give a very distinct trend line (see Fig. 1 in supplementary checklist), with increasing species diversity towards the north ($R^2 = 0.84$). The considerably lower species numbers (316 and 320) from the two oceanic excursions to the Faeroe Islands in 1995 (Alstrup et al. 1999) and eastern Iceland in 1997 (Kristinsson 1999) reduce the R^2 value to 0.49 when included. We suggest that the low value is linked to the lower habitat diversity related to rock types, forests, climate, altitude, and overall grazing rather than to oceanity itself.

We have found it difficult to find reports of areas with such high local lichen species diversity in the literature. Strikingly enough, the other ‘competing’ records known to us also occur within northern Fennoscandia. We have already mentioned the high diversity near Vega (Degelius 1982). In addition, Magnusson (1952) listed about 720 lichens and 34 lichenicolous fungi from the Torneträsk area in northernmost Sweden, Alstrup (1986) and Tibell (1988) reported 11 and 22 more species new to Torne Lappmark, respectively, and Alstrup (1991) reported another 117 lichens and 28 lichenicolous fungi for the region.

Comparisons are not straightforward in that the Torneträsk area is somewhat larger than Skibotn, several taxa listed by Magnusson (1952) would not be accepted today while some additional taxa may also be known. A new review of the local lichen mycota of the western Torneträsk area would be of great interest in a biodiversity context, as the above references suggest a species number near 900, possibly the most species-rich local lichen mycota known in the world. Torneträsk is even better explored, as is illustrated by several conspicuous omissions from the Skibotn list (e.g. *Protoparmeliopsis muralis*

and *Pannaria hookeri*). In addition, some species (*Umbilicaria crustulosa*, *U. havaasii*, *U. nylanderiana*; cf. Hakulinen 1962 and *Bryoria lanestris*; cf. A. Elvebakk 00:085, TROM) have been reported or collected in Finland close to the Norwegian border. Comparisons between the Skibotn and Torneträsk areas should also consider that the latter includes only altitudes above c. 340 m.

Table 1—Species recorded as new to the county of Troms.

(**Bold italic** denotes species new to North Norway; N* = new to Norway; F* = new to Fennoscandia.)

<i>Ameliella grisea</i> N*	<i>Hymenelia melanocarpa</i>	<i>Polyblastia cruenta</i>
Coppins & Fryday ined.	<i>Lecania subfuscula</i>	<i>Polyblastia hyperborea</i>
<i>Anzina carneonivea</i>	<i>Lecanora actophila</i>	<i>Polyblastia peminosa</i>
<i>Aspicilia aquatica</i>	<i>Lecanora andrewii</i>	<i>Polyblastia terrestris</i>
<i>Aspicilia caesiocinerea</i>	<i>Lecanora cavicola</i>	<i>Polysporina ferruginea</i>
<i>Aspicilia mastrucata</i>	<i>Lecanora chloroleprosa</i>	<i>Porina mammosa</i>
<i>Aspicilia montana</i>	<i>Lecanora chlorophaeodes</i>	<i>Porpidia cinereoatra</i>
<i>Bacidia igniarii</i>	<i>Lecanora flotoiwiana</i> N*	<i>Porpidia tuberculosa</i>
<i>Baeomyces carneus</i>	<i>Lecanora hypoptella</i>	<i>Protoparmelia oleagina</i>
<i>Bryophagus gloeocapsa</i>	<i>Lecanora perpruinosa</i> N*	<i>Pseudosagedia chlorotica</i>
<i>Buellia aethalea</i>	<i>Lecanora rimicola</i>	<i>Psorotichia schaereri</i>
<i>Buellia ectolechioides</i>	<i>Lecanora subintricata</i>	<i>Pyrenopsis furfurea</i>
<i>Buellia pulverulenta</i>	<i>Lecidea confluens</i>	<i>Rhizocarpon amphibium</i>
<i>Caloplaca approximata</i>	<i>Lecidea fuliginosa</i>	<i>Rhizocarpon atroflavescens</i>
<i>Caloplaca atrocyaneus</i> N*	<i>Lecidella carpatica</i>	<i>Rimularia badioatra</i>
<i>Caloplaca cerinelloides</i>	<i>Lecidella euphorea</i>	<i>Rimularia impavida</i>
<i>Caloplaca diphodes</i>	<i>Lecidella wulfenii</i>	<i>Rinodina parasitica</i>
<i>Caloplaca exsecuta</i>	<i>Leciophysma furfurascens</i>	<i>Scoliciosporum umbrinum</i>
<i>Caloplaca grimmiae</i>	<i>Lempholemma isidiodes</i>	<i>Squamaria degelii</i>
<i>Caloplaca nivalis</i>	<i>Lempholemma polyanthes</i>	<i>Staurothele areolata</i>
<i>Caloplaca spitsbergensis</i> F*	<i>Lepraria borealis</i>	<i>Stereocaulon arcticum</i>
<i>Caloplaca tetraspora</i>	<i>Lepraria cacuminum</i>	<i>Stereocaulon groenlandicum</i> F*
<i>Caloplaca tornoënsis</i>	<i>Lepraria diffusa</i> var.	<i>Stereocaulon leucophaeopsis</i>
<i>Calvitimela perlata</i>	<i>chrysodetoides</i>	<i>Stereocaulon saxatile</i>
<i>Candelariella coralliza</i>	<i>Lepraria rigidula</i>	<i>Stereocaulon tornense</i>
<i>Carbonea atronivea</i>	<i>Leptogium tenuissimum</i>	<i>Strigula muscicola</i> N*
<i>Carbonea intrusa</i>	<i>Lichinodium sirosiphoideum</i>	F. Berger, Coppins, Cl. Roux & Sérus. ined.
<i>Catillaria contristans</i>	<i>Melanella tominii</i>	<i>Thelidium incavatum</i>
<i>Catolechia wahlenbergii</i>	<i>Micarea cinerea</i> f. <i>tenuispora</i>	<i>Thelidium pluvium</i>
<i>Cercidospora decolorata</i>	<i>Micarea denigrata</i>	<i>Thelocarpon impresellum</i>
<i>Cladonia macrophyllodes</i>	<i>Micarea incrassata</i>	<i>Trapeliopsis pseudogranulosa</i>
<i>Cladonia stygia</i>	<i>Micarea melaena</i>	<i>Usnea hirta</i>
<i>Collemopsisidium halodytes</i>	<i>Micarea turfosa</i>	<i>Verrucaria halophila</i>
<i>Cystocoleus ebeneus</i>	<i>Miriquidica complanata</i>	<i>Verrucaria halophiloides</i>
<i>Endocarpon pulvinatum</i>	<i>Miriquidica intrudens</i>	<i>Verrucaria latebrosa</i>
<i>Endocarpon pusillum</i>	<i>Miriquidica obnubila</i>	<i>Verrucaria praetermissa</i>
<i>Ephebe hispidula</i>	<i>Miriquidica plumbeoatra</i> N*	<i>Vulpicida tubulosus</i>
<i>Helocarpon crassipes</i>	<i>Pertusaria coccodes</i>	<i>Xanthomendoza borealis</i>
<i>Hymenelia arctica</i>	<i>Placynthium dolichoterum</i>	(R. Sant. & Poelt) Søchting et al.
<i>Hymenelia cyanocarpa</i>	<i>Placynthium rosulans</i>	

To conclude, the local lichen mycotas from the northern Fennoscandian sites Skibotn, Torneträsk and Vega show extraordinarily high species diversities, contradicting the general latitudinal trends in biodiversity. While no doubt a result of intensive studies by specialists, the high species richness can also be explained by a higher topographical and climatic diversity, higher diversity in substrate types, and also a higher degree of open rock surfaces, as compared to landscapes dominated by forests and agricultural activity further to the south. On a global scale, however, more efforts are needed to obtain knowledge on local lichen biodiversity. This is illustrated by the fact that Aptroot (2001) recorded an impressive 173 lichen species on a single tree in Papua New Guinea; only half of them determined with certainty to species level.

Proposed additions to the Norwegian red-list of threatened lichens

A revision of the Norwegian red-list of threatened species is under preparation (www.artsdatabanken.no). In keeping with the above results we suggest that the following species be included among threatened macrolichens in Norway: *Cladonia macroceras*, *Collema ceranicum*, *Melanelia agnata*, *Stereocaulon arenarium*, *S. groenlandicum*, *Vulpicida tubulosus* and *Xanthomendoza borealis*, in addition to the small-fruticulose *Leciophysma* species.

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Thanks to all Excursion participants for their contributions to the now vastly improved knowledge of the lichen mycota of the Skibotn area, and particularly to the many participants who submitted information on their own collections. This represented many additions to the species list, and improves much the documentation of the collections, now mostly housed in the participants' home herbaria. We are also grateful to the University of Tromsø, for a grant allowing us to combine the Excursion with a Symposium, for comments from peer reviewers Vagn Alstrup and Tor Tønsberg, to Virginie Ramasco for assistance in the manuscript preparation process, and to the Norwegian Water Resources and Energy Directorate (NVE), who allowed us to use their normally closed mountain road.

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A new species of *Didymium* (Myxomycetes) with reticulate spores

YURI K. NOVOZHILOV ^{1*} & INNA V. ZEMLYANSKAYA ²

yurinovozhilov@gmail.com

¹V.L. Komarov Botanical Institute of the Russian Academy of Sciences
Prof. Popov St. 2, 197376 St. Petersburg, Russia

²Volgograd State Medicinal University
Pavshikh Boitzov Square 1, 400066 Volgograd, Russia

Abstract—An undescribed species of myxomycete characterized by distinct banded-reticulate spores and the absence of a capillitium was isolated in moist chamber culture from the litter of white sagebrush (*Artemisia lercheana*) collected in a steppe community in the Volgograd region of Russia. A description of this new species and scanning electron photographs are presented. Characters distinguishing this species from *D. atrichum*, *D. nullifilum* and *D. subreticulosporum* are outlined. The taxonomic limits of the species are discussed.

Key words—Physariales, Didymiaceae, steppe

Introduction

The genus *Didymium* was erected by Schrader (1797) for *Didymium farinaceum* Schrad. (= *D. melanospermum* (Pers.) T. Macbr.) based upon the crystalline structure of the lime on the peridium. The majority of species of *Didymium* have a well-developed capillitium, but some species appear to lack a capillitium. *Didymium atrichum* Henney & Alexop. (Henney et al. 1980) and *D. nullifilum* (Kowalski) M.L. Farr (Farr 1982) are good examples of species with a reduced capillitium. During a study of myxomycetes in desert and steppe regions of the Caspian Lowland (Russia), we observed what appeared to be a species of *Didymium* without a capillitium while examining moist chamber cultures of litter of white sagebrush (*Artemisia lercheana* Weber), collected from a study site in a steppe community near the city of Volgograd. The fruit bodies of this myxomycete consisted of snow-white or ash grey subglobose or pulvinate slightly flattened sporangia with peridium covered with polygonal minute lime crystals and scales. Based on the structure of the lime on the peridium and colour of the spore mass, it was suspected that these sporangia represented a species of *Didymium*. The eight specimens consisting of several hundred sporangia are in very good condition. More detailed observation of this material confirmed that it represented an undescribed species of *Didymium*, which is described herein.

* Corresponding author

Materials and methods

This study is based on material collected from moist chamber cultures. Samples of litter of *Artemisia lercheana* were placed on filter paper in Petri dishes. Cultures were moistened with distilled water adjusted to pH 7.0 and maintained up to 1 month under diffuse daylight at room temperature (22–23°C). After 10 days several hundred sporangia of a distinct and undescribed species of myxomycete developed in these moist chambers. Some sporangia were used in attempts to establish spore to spore cultures but these were unfortunately unsuccessful. Spores were preserved as permanent slides in polyvinyl lactophenol. Air-dried sporangia were studied with a JEOL 35c scanning electron microscope at St. Petersburg; the material was mounted on copper stubs using double-sided sticky film and sputter-coated with gold up to 200–500 Å thickness. Color descriptions of sporangia are given according to Petersen (1996).

Taxonomic Description

Didymium reticulosporum Novozh. & Zeml., sp. nov.

Figure 1

Sporangia dispersa vel conferta, candida (60, Petersen 1996) *vel cinerea* (56, Petersen 1996), *ad basin compressam suffulta, pulvinata, subapplanata vel subglobosa*, 0.5–1.5 mm in diametro, *interdum pro plasmodiocarpis ad 3 mm longis*. *Hypothallus tenuis, paleaceus, inconspicuus*. *Peridium unistratosum, tenue, paleaceum, crystallis albis, polygonalibus vel squamulis calcibus densiuscule obtectum, interdum haud calcificatum*. *Columella nulla*. *Capillitium nullum*. *Massa sporarum aquila*. *Sporae globosae vel subprotractae*, 13–16 µm in diametro, *incluso dimensio ornamentationis, atropurpureo-brunneae* (3, Petersen 1996), *ornamentatione reticulatis insigni, foveolis, magnis, planis in numero 3–4 in sectione opticae sporis hemisphaerae; cristae reticuli in sectione optice 1.5–2 µm altae*. Sub SEM [microscopio scanico] *intra reticulum basalis ornamentatio reticulata secundaria pro reticulis minute alveolatis conspicua et area episporii obtegentia*.

Etymology: Refers to the distinctive ornamentation of spores.

Sporangia scattered or gregarious, snow-white (60, Petersen, 1996) or ash grey (56, Petersen, 1996) forming subglobose or pulvinate slightly flattened sporocarps, 0.5–1.5 mm diam., varying to short plasmodiocarps up to 3 mm long; **peridium** single, thin, membranous, sparsely to densely powdered with white lime polygonal minute crystals and scales, sometimes nearly limeless; **columella** absent; **capillitium** absent; **spore-mass** dark brown; **spores** globose or slightly elongated, 13–16 µm diam., including the ornamentation, very dark purplish brown, fuscous (3, Petersen 1996) to violet-brown (1, Petersen, 1996), prominently banded-reticulate with regular large 3–4 meshes across the hemisphere; the bands form a border ca. 1.5–2 µm high in optical section; in SEM the secondary reticulum with smaller meshes covering the episore is visible inside the basic reticulum; **plasmodium** hyaline to yellowish-milky.

Ecology and distribution—On the dead twigs of *Artemisia lercheana*, bark of apple-tree and litter of pear-tree.

REPRESENTATIVE SPECIMENS EXAMINED—RUSSIA. Volgograd province, THE WATERSHED OF THE VOLGA RIVER (44°21'04"E, 48°34'43"N), located at an elevation of 100 m above sea level, steppe community with *Artemisia lercheana*, within the steppe zone; isolated in moist chamber culture, on the dead twigs of *A. lercheana* collected 24.07.2001, I.V. Zemlyanskaya (HOLOTYPE-LE 204007). Volgograd province: Kamyshinskiy

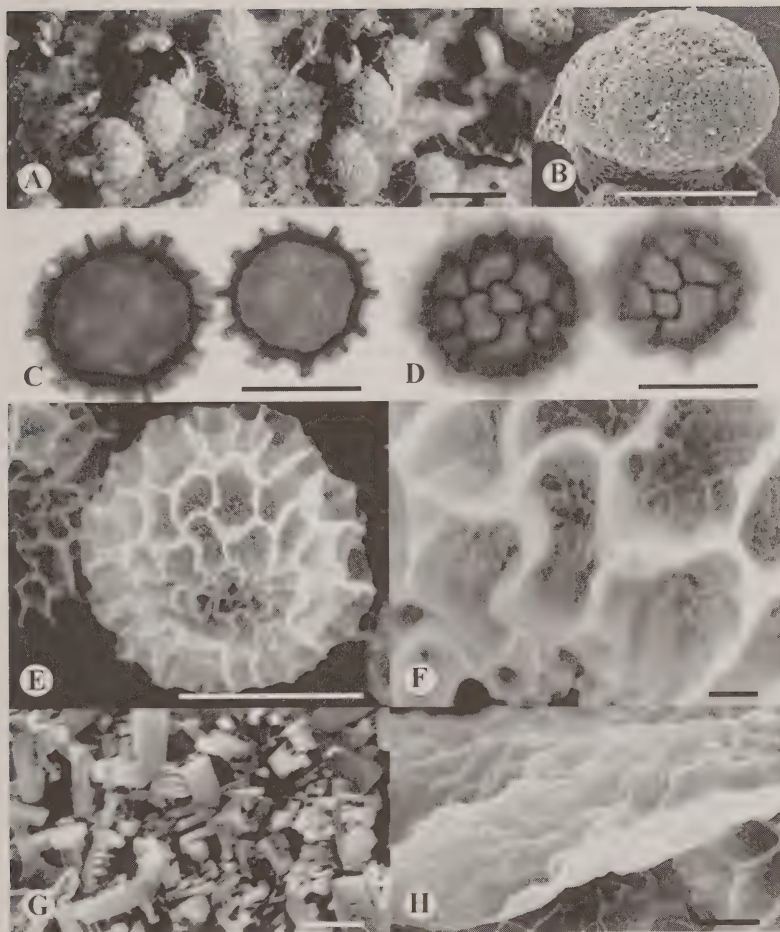


Fig. 1. Sporangia, peridium and spore morphology of *Didymium reticulosporum* (LE 204007). – A. Habit of sporangia. B. SEM micrograph of a closed sporangium. C. Polyvinyl lactophenol mount of spores in optical section. D. Polyvinyl lactophenol mount of spores in top view. E. Spore as viewed under SEM. F. Detail of spore ornamentation under SEM. G. SEM micrograph of lime polyagonal minute crystals and scales on the peridium. H. SEM micrograph of membranous peridium.

Scale bars: A, B = 1 mm, C, D, E = 10 μ m, F, G, H = 1 μ m.

district, SHCHERBATOVSKIY NATIONAL PARK, SHCHERBATOVKA VILLAGE (45°41'33"E, 50°29'36"N), on bark of apple tree and on litter of pear-tree, isolated in moist chamber culture 21.02.2005 (the private collection of Dr. I.V. Zemlyanskaya 614/1, 621/1, 621/4).

Note: An isotype has been sent to the National Fungus Collections (BPI) USA, the private collection of Dr. C. Lado (dwb, Lado), and the private collection of Dr. M. Schnittler (sc).

Comments—This species differs from species of *Diderma* in having the upper part of the peridium covered with rhomboid and polygonal crystals of lime (Fig. 1, H) and therefore belongs to the genus *Didymium*. No described species of *Didymium* with reduced capillitium appears to be closely related to this new species. *Didymium reticulosporum* differs from all other species in the genus by virtue of its unique spore ornamentation. *Didymium atrichum* has reticulate or spinulose spores, but its spores are much smaller (10–11 µm diam.) and only appear very faintly reticulate under oil immersion. *Didymium nullifilum*, another species with a reduced capillitium, has spores 8–10 µm diam. covered with widely scattered spines up to 1 µm high.

Other taxa with banded-reticulate spores have been described throughout many genera of myxomycetes, but this type of spore ornamentation is rare within *Didymium*. Only *D. subreticulosporum* Oltra, G. Moreno & Illana (Moreno et al. 1996; see also Lizárraga et al. 1998) has banded-reticulate spores; all other species of *Didymium* have spinulose, verrucose or faintly reticulate spores. However, *D. subreticulosporum* has stipitate sporocarps and its spores are much smaller (9–11 µm diam.). In contrast, *D. reticulosporum* has sessile sporocarps and large prominently banded-reticulate spores (13–16 µm) with the secondary reticulum covering the epispore, and this kind of spore ornamentation has never been observed among myxomycetes.

Acknowledgements

We wish to express our thanks to L.A. Karzeva, St. Petersburg, for technical assistance during the SEM-investigations and to Dr. A. Borodina for writing the Latin diagnosis. Prof. Harold W. Keller (Central Missouri State University) made valuable comments relating to the collection of *Didymium reticulosporum*. This work was supported by two grants (02-07-90439 and 02-04-49907) from the Russian Science Foundation [RFBR], the scientific project "Bioraznoobrazie" with additional funding provided by the Planetary Biodiversity Inventory project (Global Biodiversity of Eumycetozoa) supported by a grant (DEB-0316284) from the National Science Foundation. We are grateful to Dr. Gražina Adamonytė (Institute of Botany, Vilnius, Lithuania) and Dr. Steve L. Stephenson (Arkansas University, USA) for comments, discussion during manuscript preparation and language correction.

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**Anamorphic fungi from submerged leaves in Cuba:
Brevicatenospora enteroproliferata gen. et sp. nov. and
Beltraniopsis aquatica sp. nov.**

RAFAEL F. CASTAÑEDA RUIZ

rfcastaneda@inifat.co.cu

Instituto de Investigaciones Fundamentales en Agricultura Tropical “Alejandro de Humboldt”

Calle 1 Esq. 2, Santiago de Las Vegas, C. Habana, Cuba. C.P. 17200

DAVID W. MINTER

d.minter@cabi.org

CABI Bioscience, Bakeham Lane

Egham, Surrey, TW20 9TY, United Kingdom

MARC STADLER

marc.stadler@t-online.de

InterMed Discovery GmbH, c/o Bayer Pharma Research Center, Bldg. 0452

P.O.B. 101709, D-42096 Wuppertal, Germany

MASATOSHI SAIKAWA

saikawa @u-gakugei.ac.jp

Department of Biology, Tokyo Gakugei University

Nukuikita-machi, Koganei-shi, Tokyo 184-8501, Japan

MAYRA CAMINO-VILARÓ

hajb@ceniai.inf.cu

Jardín Botánico Nacional, Carretera del Rocio, Km 3.5

C.P. 19230, Calabazar, Boyeros, Ciudad de La Habana, Cuba

Abstract—*Brevicatenospora enteroproliferata* anam. gen. et sp. nov. and *Beltraniopsis aquatica* anam. sp. nov. are described and illustrated on decaying leaves of *Andira inermis* and an unidentified plant submerged in the ‘Ancón’ stream, Mil Cumbres, Pinar del Rio Province, Cuba. The former is distinguished by hologenous, unilocal, indeterminate conidiogenous cells with numerous enteroblastic percurrent proliferations and polymorphic unicellular, red-brown to dark brown conidia in short chains and the latter is characterized by unicellular, fusiform to navicular, brown conidia.

Key words—fresh water, systematics, tropical fungi, hyphomycetes

Introduction

In contrast to other habitats, freshwater biotopes have so far been widely neglected during inventories of tropical fungal biodiversity. In fact, submerged plant debris in tropical streams and lakes has recently turned out to harbor various undescribed taxa of conidial fungi (Castañeda et al. 2005a,b). During an expedition through the rainforest in the western mountains of Mil Cumbres, Pinar del Rio Province, Cuba, two interesting hyphomycetes were collected in 2004 on submerged decaying leaves of *Andira inermis* and an unidentified plant in a stream. They showed remarkable differences from previously described hyphomycetes and are therefore, described as a new genus and species. We report here their characteristics, based on microscopic studies that were carried out as described in Castañeda et al. (2005a)

Taxonomy

Brevicatenospora R.F. Castañeda, Minter & Saikawa **anam. gen. nov.**

Ad fungos conidiales, hyphomycetes pertinens. Coloniae effusae, brunneae usque rubro-brunneae vel nigrae. Conidiophora conspicua, septata, brunnea usque ad atrobrunnea. Cellulae conidiogenae uniloculosae, hologenosae, indeterminatae, cum multis proliferationibus enteroblasticis percurrentis. Loci conidiogeni apicales. Secessio conidiorum schizolytica. Conidia acrogena, unicellularia vel septata, catenulata, polymorpha, obovata, globosa, pyriformia, globosa, clavata, spathulata usque ad capitata, brunnea, rubro-brunnea usque ad nigra, levia vel verrucosa. Teleomorphosis ignota.

Etymology: Latin, *brevi*, meaning short; *catena*, meaning chain; *spora*, referring to the conidia.

Typus: *Brevicatenospora enteroproliferata* sp. nov.

Conidial fungi, hyphomycetes. **Colonies** effuse, brown to red-brown or black. **Conidiophores** differentiated, septate, brown to dark brown. **Conidiogenous cells** unilocal, hogenous, indeterminate with numerous enteroblastic percurrent proliferations. **Conidiogenous loci** apical. **Conidial secession** schizolytic. **Conidia** acrogenous, unicellular or with one septum, polymorphic, ranging from obovate, globose, pyriform, clavate, spathulate to capitate, brown, red-brown to black, smooth-walled or verrucose, catenulate. **Teleomorph**: unknown.

COMMENTS— *Brevicatenospora* is somewhat similar to the genera *Annellophora* S. Hughes (Hughes 1951), *Acrogenospora* M.B. Ellis (Ellis 1971), *Belemnospora* P.M. Kirk (Kirk 1981), *Sporidesmiella* P.M. Kirk (Kirk 1982), and *Repetophragma* Subram. (Subramanian 1992) in having hogenous, unilocal conidiogenous cells with few to several enteroblastic percurrent proliferations and delicate annellations on the apical region of the conidiophores, but catenulate conidia are not formed in any of these genera. The genera *Endophragmiella* B. Sutton (Sutton 1973) and *Ityorhoptrum* P. M. Kirk (Kirk 1986) appear superficially similar to *Brevicatenospora*; both genera have hogenous, unilocal, percurrently proliferating conidiogenous cells and solitary conidia, but the rhexolytic conidial secession separate those genera from the new one. Also, the genera *Junewangia* W.A. Baker & Morgan-Jones (Baker et al. 2002), *Camposporidium* Nawawi & Kuthub. (Nawawi A, Kuthubutheen 1988) and *Digitoramispora* R.F. Castañeda & W.B. Kendr. (Castañeda & Kendrick 1990) have analogous annellidic conidial ontogeny

with several enteroblastic extensions of the conidiogenous cells, but the solitary conidia in *Junewangia* are dictyoseptate; *Camposporidium* has phragmoconidia with several cellular appendages, whereas, septate, branched, more or less digitate conidia are present in *Digitoramispora*.

***Brevicatenospora enteroproliferata* R.F. Castañeda, Minter & Saikawa**

anam. sp. nov.

FIGURES 1–7

Coloniae effusae, brunneae usque rubro-brunneae. Mycelium partim superficiale et partim in substrato inmersum. Conidiophora conspicua, mononemata, 3– ad 7-septata, simplicia, 80–110 µm alta, 5.2–7.8 µm crassa ad basim, levia, brunnea usque ad atrobrunnea. Cellulae conidiogenae uniloculosae, holo-genosae, indeterminatae, annellatae, 3.9–6.4 µm crassa, brunneae usque pallide brunneae, cum 10–28-proliferationibus enteroblasticis percurrentibus. Loci conidiogeni apicales. Conidia acrogena, unicellularia, breviter catenulata, brunnea vel rubro-brunnea, levia, sicca, polymorpha; conidia primaria



Figs. 1–4. Photomicrographs of *Brevicatenospora enteroproliferata*, from holotype (INIEAT C04/111). Fig. 1. Conidiophore and conidiogenous cell. Fig. 2. Conidiophore with conidiogenous cells and conidia. Fig. 3. Conidiogenous cells. Fig. 4. Conidiogenous cell detached with conidium. Scale is indicated by bars.

clavata, sub-clavata ad usque leviter spathulata, utrimque truncata, 6.5–8.5 × 3.2–6.5 μm, sed 2.6–3.0 μm crassa ad apicem; conidia secundaria late obovoidea, pyriformia usque ad subglobosa, 3.9–5.2 × 3.9–4.5 μm. Teleomorphosis ignota.

Holotype: INIFAT C04/111 on submerged decaying leaves of *Andira inermis* in “Ancon” stream, Mil Cumbres, Pinar del Rio Province, Cuba. Coll. D. W. Minter and M. Camino, November 13, 2004.

Etymology: Latin, *entero*, referring to the inner wall; *proliferata*, meaning extended.

Colonies on the natural substratum effuse, brown to red-brown. Mycelium superficial and immersed. **Conidiophores** macronematous, mononematous, 3- to 7-septate,



Figs. 5–7. Drawings of *Brevicatenospora enteroproliferata*, from holotype (INIFAT C04/111).
 Fig. 5. Conidiophore and conidiogenous cell. Fig. 6. Conidiophore with conidiogenous cells and attached conidia. Fig. 7. Primary and secondary conidia partially detached.
 Scale is indicated by bars (10 μm).

simple, 80–110 μm tall, 5.2–7.8 μm wide at the base, smooth-walled, brown to dark brown. **Conidiogenous cells** unilocal, hogenous, 3.9–6.4 μm wide, indeterminate, annellidic with 10–28–enteroblastic percurrent proliferations. **Conidiogenous loci** apical. **Conidial secession** schizolytic. **Conidia** acrogenous, one-celled, brown to red-brown, smooth-walled, dry, forming short, simple chains, usually remaining adhering to the axis of the conidiophores, polymorphic; primary conidia clavate, subclavate, to slightly spathulate, truncated at the ends, 6.5–8.5 $\times$ 3.2–6.5 μm , 2.6–3.0 μm near the apex; secondary conidia obovoid, pyriform to subglobose. 3.9–5.2 $\times$ 3.9–4.5 μm . Teleomorph: unknown.

Beltraniopsis aquatica R.F. Castañeda & M. Stadler anam. sp. nov.

FIGURES 8–15

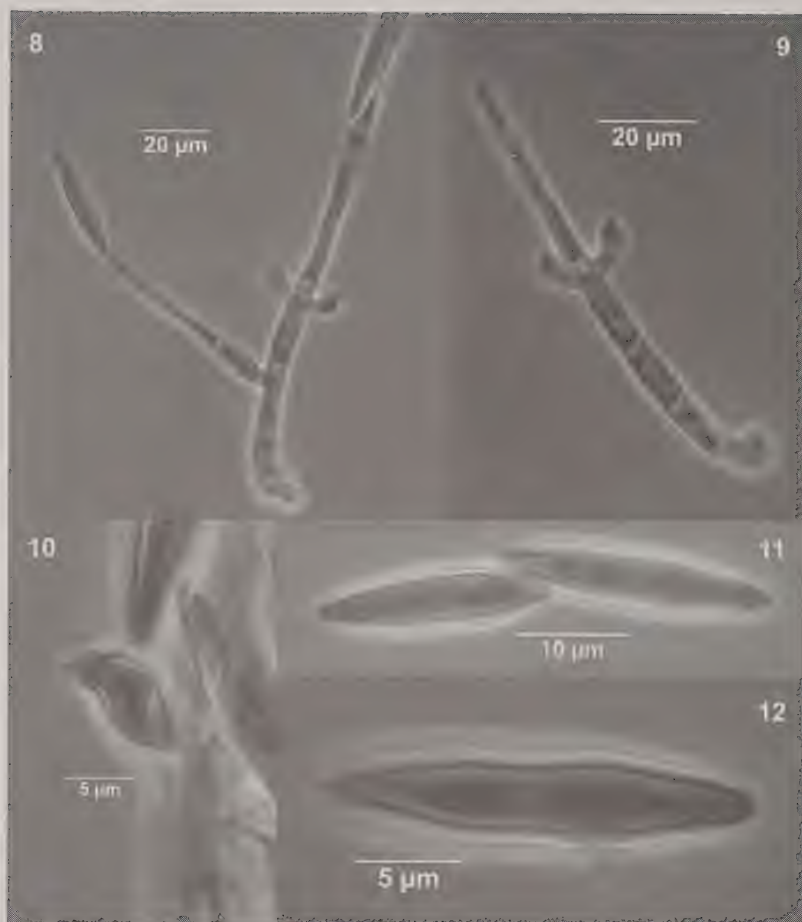
Ad omnibus speciebus Beltraniopsis differt ob conidia solitaria, acrogena, fusiformia ad usque navicularia, leviter constricta ad centrum, sicca vel leviter verruculosa, levia, brunnea, 18.2–23.4 $\times$ 3.9–5.2 μm .

Holotype: INIFAT C04/101 on submerged decaying leaves of an unidentified plant in “Ancon” stream, Mil Cumbres, Pinar del Rio Province, Cuba. Coll. D. W. Minter and M. Camino, November 13, 2004.

Etymology: Latin, *aquatica*, refers to its growing in water.

Colonies on natural substratum effuse, brown. Mycelium mostly immersed, composed of septate, unbranched, 1.3–2.0 μm diam., pale brown to brown, smooth-walled hyphae. **Conidiophores** macronematous, mononematous, sometimes forming a fasciculate group, setiform, rounded or slightly clavate at the apex, inflated at the base, 68–90 μm long, 6.5–9.1 μm wide at the base, 3– to 7-septate, branched in the median part, smooth-walled, brown at the base, pale brown to subhyaline towards the apex. **Conidiogenous cells** multilocal, hogenous, 6.5–10.5 $\times$ 4.0–4.5 μm , sympodially proliferating, indeterminate, discrete. **Separating cells** absent. **Conidiogenous loci** denticulate; denticles 0.6–1.3 μm long. **Conidial secession** schizolytic. **Conidia** solitary, pleurogenous, fusiform to navicular, slightly constricted at the middle, brown, smooth-walled, sometimes minutely verruculose, obtuse to round at the apex and attenuated, truncated at the base, 18.2–23.4 $\times$ 3.9–5.2 μm , dry. Teleomorph unknown.

COMMENTS—Seven species have been described in the genus *Beltraniopsis* thus far: *B. esenbeckiae* Bat. & J.L. Bezerra, the type species (Batista & Bezerra 1960), *B. asperisetifer* Matsush. (Matsushima 1971), *B. tanzaniensis* Piroz. (Pirozynski 1972), *B. fabularis* Rambelli & C. Ciccar. (Rambelli & Ciccarone 1987), *B. ramosa* R.F. Castañeda (Castañeda & Arnold 1985), *B. rhombispora* Matsush. (Matsushima 1993) and *B. miconiae* Gusmão & Grandi (Gusmão et al. 2000). Among these taxa, *B. aquatica* is superficially similar to *B. rhombispora*, it has conidia 15–21 $\times$ 3–4 μm that are almost the same size of *B. aquatica*, but conidia in *B. rhombispora* are rhombic to biconic, smooth-walled, and pale olivaceous. Also both taxa lack the separating cells present in other previously described species.



Figs. 8–12. Photomicrographs of *Beltraniopsis aquatica*, from holotype (INIFAT C94/101).

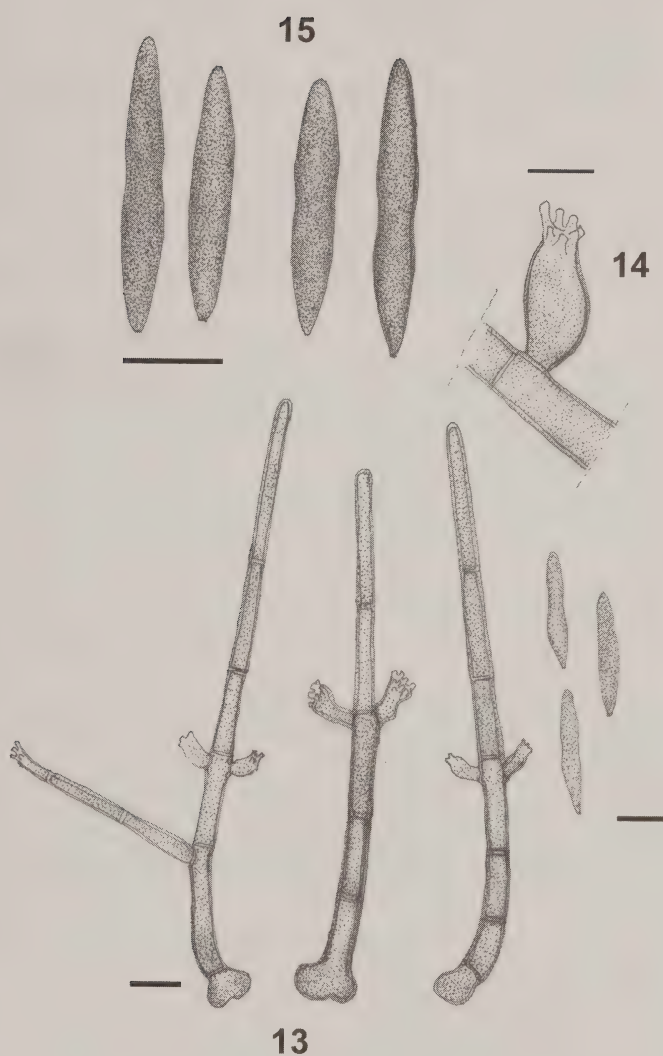
Fig. 8. Branched conidiophore. Fig. 9. Simple conidiophore.

Fig. 10. Conidiogenous cells. Figs. 11–12. Conidia.

Scale is indicated by bars.

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Figs. 13–15. Drawings of *Beltraniopsis aquatica*, from holotype (INIFAT C94/101)

Fig. 13. Conidiophores. Fig. 14. Conidiogenous cell. Fig. 15. Conidia.

Scale is indicated by bars (10 μm in Figs. 15 and 17; 5 μm in Fig. 16. e

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Leptosphaeria raphani* does not occur on *Draba aspera

DAVID L. HAWKSWORTH

myconova@terra.es

MycoNova, The Yellow House, Calle Aguila 12, Colonia La Maliciosa
Mataelpino, ES-28492 Madrid, Spain

Abstract—The specimen on which the report of the occurrence of *Leptosphaeria raphani* on *Draba aspera* in Montenegro (Republic of Serbia and Montenegro) was based has been compared with the holotype of that name. The species on *Draba* differs from *L. raphani* in having more darkly pigmented ascospores which are elongate-ellipsoid not broadly fusiform, have all cells equal in length, and are shorter and wider, with a lower length/breadth ratio. The specimen from Montenegro is clearly a different species, and requires further study to determine if it is new. Canadian material reported on *Arabis alpina* and *Draba oblongata* could, on the basis of the published information, be conspecific with the Montenegrin. *Leptosphaeria raphani* is currently only definitely known from *Raphanus maritimus* in the UK.

Key words—*Arabis*, *Dothideomycetes*, misidentifications, MYCOTAXON policy, *Phaeosphaeriaceae*, *Raphanus*

Introduction

Leptosphaeria raphani D. Hawksw. & Sivan. 1975 was originally described from the base of dying stems of *Raphanus maritimus* (*Cruciferae*) on the shingle ridge of what is now the Slapton Ley National Nature Reserve in South Devon in the UK (Hawksworth & Sivanesan 1975). Subsequently, Shoemaker (1984) referred two collections on other crucifers, *Arabis alpina* and *Draba oblongata*, to *L. raphani* but did not examine the holotype or “authenticated material” and was careful to stress the disposition was provisional. The species was also illustrated in Ellis & Ellis (1985) whose drawings were prepared from the holotype.

In December 2004 I received a paper to referee for MYCOTAXON reporting the species from *D. aspera* in Montenegro (Republic of Serbia and Montenegro). There were substantive differences in the description and photographs provided from the original account of *L. raphani*, and I recommended the paper not be submitted until the holotype and the Canadian specimens had been examined. My report was also copied to André Aptroot (then at the Centraalbureau voor Schimmelcultures, Utrecht) as he was thanked in the manuscript for ‘verification of identification’. I was therefore surprised to see the paper published almost unchanged in MYCOTAXON without my being acknowledged as one of the referees (Vukojević et al. 2005).

In order to clarify the matter, I borrowed the holotype of *L. raphani* from IMI (CABI Bioscience, Egham, UK) and the Montenegrin collection from BEOU (Botanical Institute and Garden, University of Belgrade). This note reports the results of my side-by-side comparison of these two collections, which established that the Montenegrin report was based on a misidentification.

Materials and Methods

The permanently preserved slides in both collections were examined using an Olympus BH2 microscope fitted with Nomarski Differential Interference Microscopy and a drawing tube. A selection of ascospores free of the asci were drawn to show the range in shape and size, and sizes and length/breadth ratios were noted.

SPECIMENS EXAMINED -- SERBIA AND MONTENEGRO: MONTENEGRO: MAJA KOLATA (MT. PROKLETIJE), 2530 m, on leaves of *Draba aspera*, 5 July 1995, B. Stevanović et al. (BEOU). -- UNITED KINGDOM: ENGLAND: SOUTH DEVONSHIRE: SLAPTON, SLAPTON LEY NATIONAL NATURE RESERVE, ca. 10 m, on dead stems of *Raphanus maritimus* on the shingle ridge, 15 Aug. 1973, D. L. Hawksworth 3563 (IMI 178278 -- HOLOTYPE of *Leptosphaeria raphani*).

Results and Discussion

The suspicion that the two collections represented different species was confirmed. The ascospores differ in colour, shape, size, length/breadth ratio, constrictions, and the relative sizes of the cells (Table 1, Fig. 1). As these details match the pertinent published drawings and photographs, it is evident that they are not artefacts of preservation. The ascospore sizes given below are from the preserved slides, and somewhat larger ranges are given in the pertinent publications: 20-26 x 4-5 µm for IMI 178278 (Hawksworth & Sivanesan 1975) and 17.5-23.7 x 5-7.5 µm for that in BEOU (Vukojević et al. 2005), presumably because many more spores were measured. In addition, the sizes of the ascomata differ substantially and hardly overlap in width, measuring 275-325 x 200-259 µm in IMI 178278 (Hawksworth & Sivanesan 1975) and only 164-230 x 130-225

Table 1. A comparison of the ascospore characters in the two collections named as *Leptosphaeria raphani* examined.

Character	IMI 178278 (holotype)	BEOU
Colour	Yellow-brown	Red-brown
Shape	Broadly fusiform	Broadly ellipsoid
Apices	Attenuated	Rounded
Constrictions	Median septum only	All septa
Cell size	The two central cells the longest	All cells ± equal in size
Size	20.5-24 x 4.5-5.5 µm	17-17.5 x 5-6 µm
Length/breadth ratio	3.9-5.0	2.9-3.5

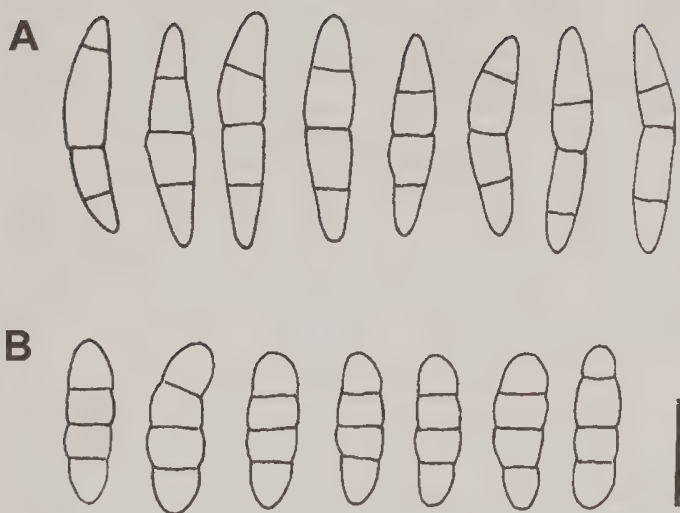


Fig. 1. Ascospore shape and septation in "*Leptosphaeria raphani*". (A) IMI 178278 (holotype) on *Raphanus maritimus*; and (B) BEOU on *Draba aspera*. Scale bar = 10 μm .

μm in the BEOU collection (Vukojević et al. 2005). While it might be true that the dimensions of the ascomata might be "a result of development on different hosts and in different environmental conditions" (Vukojević et al. 2005: 266), such factors could not explain the fundamental differences in the ascospores. Indeed, the features of ascospore colour, shape, and septation patterns are regularly used in species delimitation in this and allied genera (e.g. Leuchtman 1984; Shoemaker 1984); to allow such a range of variation within a single *Leptosphaeria* species would shake the foundations of the current taxonomy of the genus.

The detailed descriptions of the two Canadian collections on *Arabis alpina* and *Draba oblongata*, and especially the photograph of the ascospores, provided by Shoemaker (1984: 2726, fig. 145), suggest that he was also dealing with a different species. The ascomata were stated as being larger than in the Montenegrin collection (200–280 $\times$ 200–280 μm) and the ascospores (15–20 $\times$ 4.5–5 μm) had shorter central cells and were more elongate than in the BEOU collection, and further not clearly constricted at septa apart from the median one.

In concluding that the UK collection is distinct and that the name *Leptosphaeria raphani* has been wrongly applied, what names should be used for the other specimens? It might be tempting to describe two additional new species, but as there are already at least 29 species names introduced for *Leptosphaeria*'s (s. lat.) on *Cruciferae* (Crane & Shearer 1991) I believe that it would be irresponsible to do that without an investigation of the application of all those names.

There are perhaps three main lessons for mycologists in general from this investigation. (1) If you are going to report a fungus on a new host, first compare the material with type or authentic specimens and do not rely on descriptions or identifications by others who have not made such a comparison¹. (2) Do not ignore referees' comments because they might mean more work as to do so may cause you public embarrassment. And (3) MYCOTAXON's policy of now requesting all referees' reports to be copied separately to the Editor-in-Chief is in the interests of avoiding mistakes entering the scientific literature.

I might add that this is not the first time there have been instances of papers appearing in MYCOTAXON where my comments as a referee have been ignored, though in those cases I was acknowledged, thus implying I agreed with the conclusions when I certainly did not! I refrain from mentioning those here, until I can find time to write more notes in a similar vein – but they did not involve a species name I had introduced that I did not wish to see being misapplied.

Acknowledgements

I am grateful to Paul M. Kirk (CABI Bioscience, Egham) for arranging the loan of the holotype of *Leptosphaeria raphani*, and to Jelena Vukojević (University of Belgrade) for the loan of the Montenegrin collection reported as *L. raphani*. J. Leland Crane (Illinois Natural History Survey, Champaign) and Rajesh Jeewon (University of Hong Kong) kindly acted as referees for this paper.

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¹ If for any reason type or authentic material is not available, endeavour to collect material on the same host for comparison (ideally also from the same region as the holotype); where no original material remains or it no longer exhibits particular characters, a neotype or epiptye respectively can be designated to fix its application for the future.

***Drechslerella brochopaga*,
the anamorph of *Orbilia (Hyalinia) orientalis***

ZEFEN YU¹, YING ZHANG¹, MIN QIAO¹, H.-O. BARAL²,
E. WEBER² & KEQIN ZHANG^{1*}

*Kqzhang111@yahoo.com.cn

¹Laboratory for Conservation and Utilization of Bio-resource
Yunnan University, Kunming, Yunnan 650091, PR China

²Blaihofstrasse 42, D-72074 Tübingen, Germany

Abstract—Cultures derived from three collections of *Orbilia* (formerly *Hyalinia*) *orientalis* produced an anamorph, which could be identified as *Drechslerella brochopaga*. The cultures formed constricting rings when nematodes *Panagrellus redivivus* were added. Both teleomorph and anamorph are illustrated and described. In addition, the new combination *Orbilia tenebricosa* is proposed.

Keywords—*Orbilia orientalis*, anamorph-teleomorph connection

Introduction

The genus *Orbilia* Fr. is a globally distributed genus comprising more than 200 species (Baral et al., in prep.). Its history was simply reviewed by Liu et al. (2005a). *Orbilia* has not been a major focus of mycologists because of the perceived low economic importance of the genus and minute size of the apothecia (Alexopoulos et al. 1996). However, Pfister (1994) reported predacious capabilities for some species of *Orbilia* and their *Arthrobotrys* anamorphs, and further data on nematode trapping in *Orbiliaceae* were subsequently supplied by Liu et al. (2005a, b) and Mo et al. (2005a, b). These authors also summarized known anamorphs of *Orbilia* (Liu et al. 2005a, Mo et al. 2005a). However, *Helicoon* Morgan (Pfister 1997) was excluded because its teleomorph was separated from other *Orbilia* spp. in the analysis of ITS regions (Hagedorn & Scholler 1999), and an *Idriella*-like anamorph (Haines & Egger 1982) was excluded because its teleomorph was not referable to *Orbilia* (Baral et al., in prep.).

The genus concept of predacious hyphomycetes was emended by Scholler et al. (1999) on the basis of ITS and 18S rDNA sequence data (Hagedorn & Scholler 1999) and, according to the phylogenies inferred from sequence analyses of 28S rDNA, 5.8S rDNA and β -tubulin genes, further emended by Li et al. (2006).

Pfister (1997) and Scholler et al. (1999) included the sequence data of one and two strains of *Drechslerella brochopaga* (at that time without known teleomorph connection) respectively in their phylogenetic study of *Orbiliaceae*. During study of *Orbilia* and their

anamorphs, we found that *Orbilbia orientalis* produced a nematode-trapping anamorph. After a detailed examination, the fungus was identified as *Drechslerella brochopaga*.

Material and methods

Fresh specimens of *Orbilbia orientalis* were collected in China (on decaying bark of broad-leaved tree in a forest at 848 m altitude, located in Jinggangshan Park of Jian City, Jiangxi province, in October 2005, Y. Zhang. A dried voucher specimen was deposited in the Laboratory for Conservation and Utilization of Bio-resource, Yunnan Province, China. YMFT 1.01892) and in France (on rotten bark on lower face of *Corylus avellana* branch lying on ground, c. 20 m altitude, N of St. Gemme la Plaine, Dept. Vendée, 6.VI.2003, J. L. Surault, H.B. 7379; on rottten wood of *Carpinus betulus* branch lying on moist ground, c. 110 m altitude, Forêt d'Aulnay, dept. Deux-Sèvres, 28.VI.2006, P. Tanchaud, H.B. 8146a). To isolate its anamorph, several apothecia were fixed to the lid of a Petri dish with their hymenia upside down to shoot ascospores on the surface of CMA (20 g corn meal, 18g agar, 40 mg streptomycin, 30 mg ampicillin, 1000 ml distilled water).

Spore deposits from all apothecia produced the same anamorph. The Petri-dishes with apothecia were placed 4-6 days at room temperature until ascospore germination was seen on the CMA. The ascospores were transferred onto PDA plates and CMA plates respectively. After incubating 7-10 days at 25°, conidiophores and conidia were observed and measured with an Olympus B51 microscope with differential interference contrast and a Zeiss Standard 20 microscope. Trapping organs were induced by adding about 100 nematodes (*Panagrellus redivivus* Goodey) into a 1cm × 1cm square slot at the margins of the colony where the agar was removed.

In one of the two French collections (H.B. 7379), the anamorph (conidiophores and conidia) was only obtained around the apothecium on the lid of the Petri dish; a sterile transfer of mycelium and conidia in order to obtain a pure culture failed.

Taxonomic Description

Teleomorph:

Orbilbia orientalis (Raitv.) Baral,

in Krieglsteiner, Regensburger Mykologische Schriften 9(1): 271. 1999

= *Hyalinia orientalis* Raitv., in Azbukina, Plantae non vasculares, Fungi et Bryopsida Orientis extremis Sovietici, Fungi, Tomus 2, Ascomycetes, p. 362, 1991

FIGURE 1

Apothecia 0.8-1.2 mm in diam. (0.3-3 mm, France), superficial, with a distinct stalk up to 0.2-0.3 mm high, scattered to gregarious on decayed bark, white and translucent throughout when moist, pale brown when dry. Disc slightly concave to flat, margin even and smooth (distinctly crenulate-toothed in French specimens). Ectal excipulum of angular or globose cells, 8.0-13.8 µm in diam. (near base 18-42 × 12-38 µm, on flanks 15-30 × 12-20 µm, France), with thin or only slightly thickened walls, towards margin of t. prismatica-angularis oriented at a high angle, marginal cells tipped by glassy processes (only observed in French specimens) up to 30-40 × 3.5-4.5 µm, curved outwards, agglutinated to form rounded teeth. Medullary excipulum rather thick, of t. globulosa (-prismatica) with intermingled hyphae, subhymenium poorly developed.

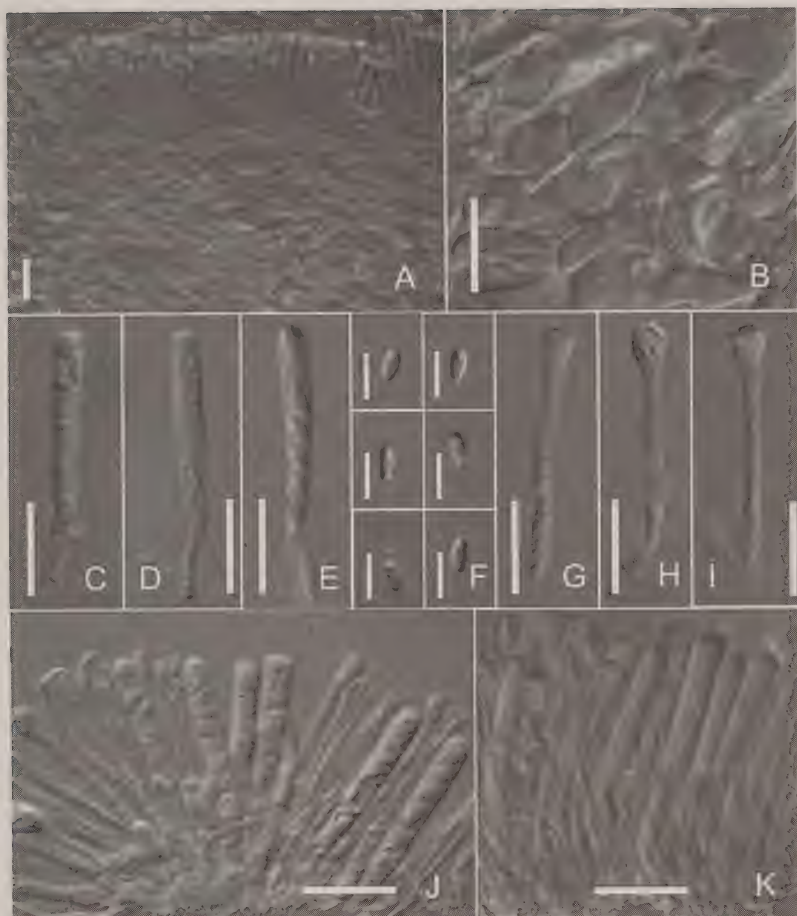


Fig. 1. *Orbilia orientalis* (YMFT 1. 01829) A. Hymenium B. Cells of ectal excipulum. C-E. Dead asci. F. Living ascospores with globose SBs. G-I. Dead paraphyses. J-K. Cluster of dead asci and paraphyses with living spores. Scale bar: A-E, G-K = 10 μ m, F = 5 μ m.

Asci $29.5\text{--}38 \times 3.2\text{--}4(-4.5)$ μ m (living state, France), 8-spored, lower (2-) 3-5(-6) spores inversely oriented (with spore body towards ascus base), cylindric, rounded or truncate at the apex (depending on side of view), tapered and often forked at the base (L, h- or H-shaped). Ascospores hyaline, non-septate, cylindric-ellipsoid, sometimes slightly tapered at lower end, $3.1\text{--}3.9 \times 1.6\text{--}1.8$ μ m (living state, France: $2.7\text{--}3.7 \times 1.3\text{--}1.6(-1.8)$ μ m), with a refractive rod-shaped spore body (SB) at upper end in living mature ascospores, $1.2\text{--}1.4 \times 0.3\text{--}0.5$ μ m in diam. (France: SB rod-shaped, attached to apex by a very fine

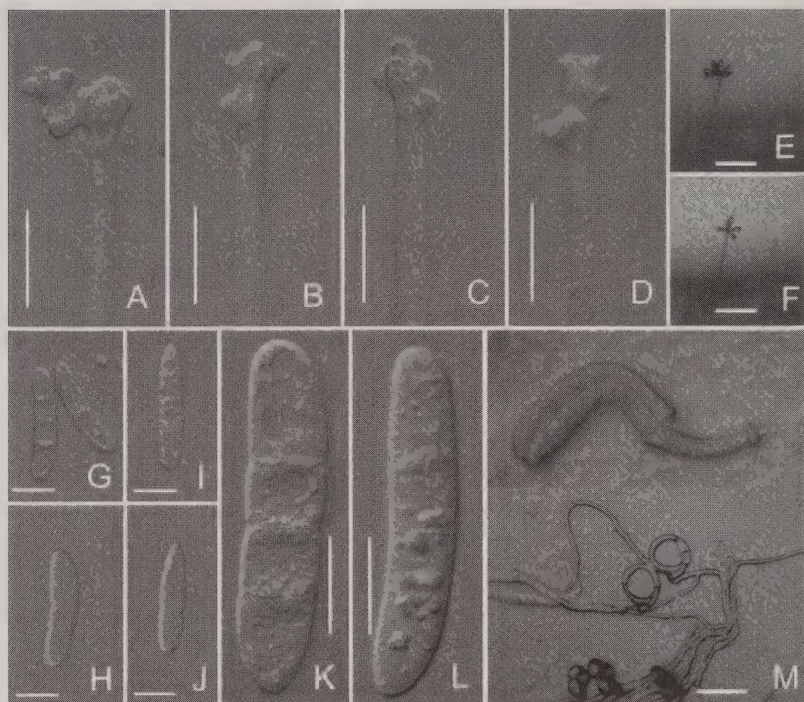


Fig. 2. *Drechslerella brochopaga* (YMF 1. 01829) A-F. Conidiophores. G-L. Conidia. M. Constricting rings.

Scale bars: A-D, G-L=10 μ m; E-F, M=50 μ m.

filum, total size $1.2-1.7 \times 0.15-0.2(-0.3)$ μ m, SB often situated at lateral wall of spore). Paraphyses $1.3-2.0$ μ m wide, enlarged to $(2.3-2.8-3.7(-4))$ μ m in diam. at the medium to rather strongly clavate or capitate apex, terminal cell much longer than lower cells, apex covered by a rough thin layer of exudate.

Anamorph:

Drechslerella brochopaga (Drechsler) M. Scholler, Hagedorn & A. Rubner,

Sydowia 51: 99, 1999

FIGURE 2

Basionym: *Dactylella brochopaga* Drechsler, Mycologia 29: 517, 1937

= *Dactylariopsis brochopaga* (Drechsler) Mekht., Mikol. Fitopatol. 1: 278, 1967

= *Arthrobotrys brochopaga* (Drechsler) S. Schenck, W.B. Kendr. & Pramer, Can. J. Bot. 55: 982, 1977

= *Candelabrella brochopaga* (Drechsler) Subram., Kavaka 5: 95, 1978 ("1977")

Colonies colorless, spreading on CMA, reaching 48 mm after 14 days at 25°. Vegetative hyphae hyaline, septate, $3.5-4$ μ m wide. Aerial mycelium sparse, hyaline, septate, branched, $2.5-4$ μ m wide. Conidiophores hyaline, erect, septate, mostly $380-430$ μ m high, $3.5-4.0$ μ m at the base, tapering upward to a width of $2-2.5$ μ m at the apex, there bearing

short blunt denticles 2-10 μm in length, whereon bearing 3-10 conidia in radiating capitate arrangement, occasionally producing up to 13 conidia in more scattered, irregularly racemose arrangement. Conidia commonly cylindric-oblong, rounded at the distal end, shortly tapered at the somewhat truncate base, $20-36 \times 5-7.5 \mu\text{m}$ (living state, France: $(27.5-31-39(-45) \times 6.5-7(-9) \mu\text{m})$), slightly to medium curved especially near distal end (straight in front view), with (1-)3 septa, predominantly 3-septate, then terminal cells often exceeding the length of the middle cells by a third or even a half (not so distinctly longer in French material). Many constricting rings with an outer diam. of 30-40 μm were observed on the CMA plates challenged with nematodes.

Discussion

Orbilia orientalis was described by Raitviir (1991) in the genus *Hyalinia* Boud., based on the presence of long glassy processes at the apothecial margin (described as "solid glassy hairs $40-60 \times 3-5 \mu\text{m}$ "). Baral (1994) has shown that such hair characters frequently vary among closely related taxa or even within a species, and therefore have little taxonomic value at generic level. Hence, *Hyalinia* is here treated as a synonym of *Orbilia*.

O. orientalis is known to us from a few records from Europe and Asia. In our collections, the ascospores are more obtuse and the paraphyses more capitate than described in the protologue (spores pointed and paraphyses only slightly clavate). However, in a restudy of the holotype specimen (TAA) by one of us (H.B.) it was found that the ascospores were actually obtuse and the paraphyses distinctly capitate. We are therefore convinced that our collections from China and Europe are conspecific with the type collection from the Far East of Russia (region of Ussur, Primorsk, north of Vladivostok).

In the collection from China, the glassy processes were very short or perhaps even absent, the apothecial margin therefore smooth. Since the other characters including the anamorph were found to be very similar among our specimens, we conclude that the presence versus absence of such processes has little taxonomic value at species level in *O. orientalis*.

Orbilia orientalis is very close to *Orbilia tenebricosa* (Svrček) Baral **comb. nov.** (Basionym: *Patinella tenebricosa* Svrček, Česká Mykol. 31: 135, 1977), from which it differs in distinctly shorter and partly thicker ascospores, also in the absence of apothecial pigmentation. For *O. tenebricosa* (sub *Patinella*) Pfister (1997) reported *Drechslerella polybrocha* (Drechsler) M. Scholler et al. as anamorph. This was the first report of an anamorph with constricting rings in the *Orbiliaceae*. The present paper is the second report of such an anamorph-teleomorph connection.

Acknowledgements

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A new species of *Agyrium* from Yunnan, ChinaWEN-YING ZHUANG^{1*} & ZHU-LIANG YANG²

zhuangwy@sun.im.ac.cn

¹Key Laboratory of Systematic Mycology & Lichenology
Institute of Microbiology, Chinese Academy of Sciences
Beijing 100080, China

fungi@mail.kib.ac.cn

²Kunming Institute of Botany, Chinese Academy of Sciences
Kunming 650204, China

Abstract — A collection of a gelatinized discomycete-like fungus associated with other fungi on decorticated wood of *Rhododendron* sp. from southwestern China is studied in detail. Morphological features indicate that it is a new species of the genus *Agyrium*. Distinctions between the Yunnan fungus and the currently accepted species of the genus, *Agyrium rufum*, are discussed.

Key words — morphology, taxonomy, *Agyrium aurantium*

Introduction

The genus *Agyrium* Fr. was established by Fries (1822), and later typified with *A. rufum* (Pers.) Fr. by Clements & Shear (1931). Thirty-two species names under the genus are currently listed in the CABI Index Fungorum website (<http://www.indexfungorum.org/Names/Names.asp>) and most of them are either synonyms of *A. rufum* or have been eliminated from the genus. Although two species were indicated in the Dictionary of the Fungi (Kirk et al. 2001), the genus seems to be monotypic (Ahti pers. comm., Kirk pers. comm.). Dennis (1978) provided a detailed description and illustration of *A. rufum* based on the British material.

A recent *Agyrium* collection on decorticated wood of *Rhododendron* sp. from southwestern China at a high elevation was examined and found to be distinct from the known species of *Agyrium*, and is described as a new taxon.

Methods by Zhuang (2005) were followed in this study.

Taxonomy

Agyrium aurantium W.Y. Zhuang & Zhu L. Yang, sp. nov.

Figs. 1–5

Ab Agyrio rufo ascomycetis pulvinatis vel cupulatis, aurantiacis; ascis 4–8-sporis, 100–110 × 13–16 µm; ascosporis ellipsoideis, 14–16.8 × 8–10 µm differt.

* Author for correspondence.

Etymology: The specific epithet refers to the fruitbody color of the fungus.

Apothecia circular, pulvinate with center depressed, broadly attached, strongly gelatinous, 0.3–0.7 mm diam when dry; hymenium and receptacle surface glabrous and orange when fresh, reddish brown when dry. Ectal excipulum of textura intricata, 20–40 μm thick, tissues strongly gelatinized, covered by a layer of gel; hyphae hyaline, 1.7–3.5 μm wide, walls somewhat glassy. Medullary excipulum of textura intricata, not clearly separated from ectal excipulum, distinct only at apothecial base, 40–50 μm thick. Hymenium ca 115 μm thick, not blue in iodine. Asci cylindrical-clavate, 100–110 $\times$ 13–16 μm , 4–8-spored, J– in Melzer's reagent, thick-walled, usually with an apical thickening, lateral walls 1–1.5 μm thick. Ascospores ellipsoid, 14–16.8 $\times$ 8–10 μm , sometimes with the lower end slightly narrower, occasionally subpyriform, non-septate, with a dark-stained area at one side in cotton blue lactophenol and a single, very large guttule, mostly uniseriate. Paraphyses immersed in gel, filiform, multiseptate, branched in the apical portion, 1.5–2 μm wide at apex and 1–1.5 μm below.

Holotype: CHINA. Yunnan. Lijiang County, Laojunshan, alt. 3700–3800 m, on decorticated wood of *Rhododendron* sp. associated with other fungi, 31 VII 2005, Z. L. Yang 4459, HKAS 48625; isotype HMAS 97510.

Notes: The new species is very similar to *Agyrium rufum* in gross morphology but differs obviously in the uniseriate ascospores 14–16.8 $\times$ 8–10 μm vs. 10–15 $\times$ 6–8 μm , 4–8-spored asci that are much larger 100–110 $\times$ 13–16 μm vs. 80 $\times$ 12 μm , and hymenium not reacting with iodine instead of blued by iodine as in *A. rufum* (Dennis 1978). We treat the above distinctions at the species level.

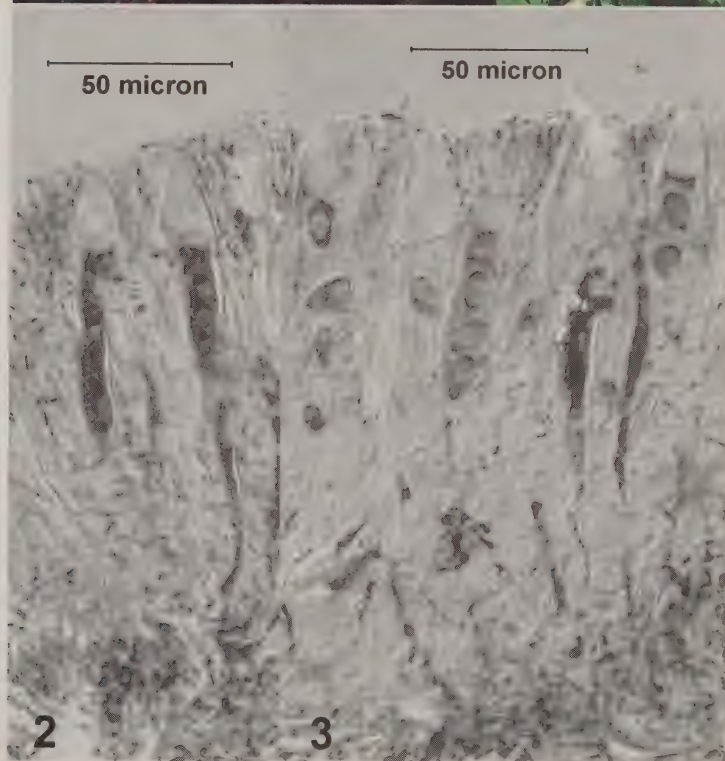
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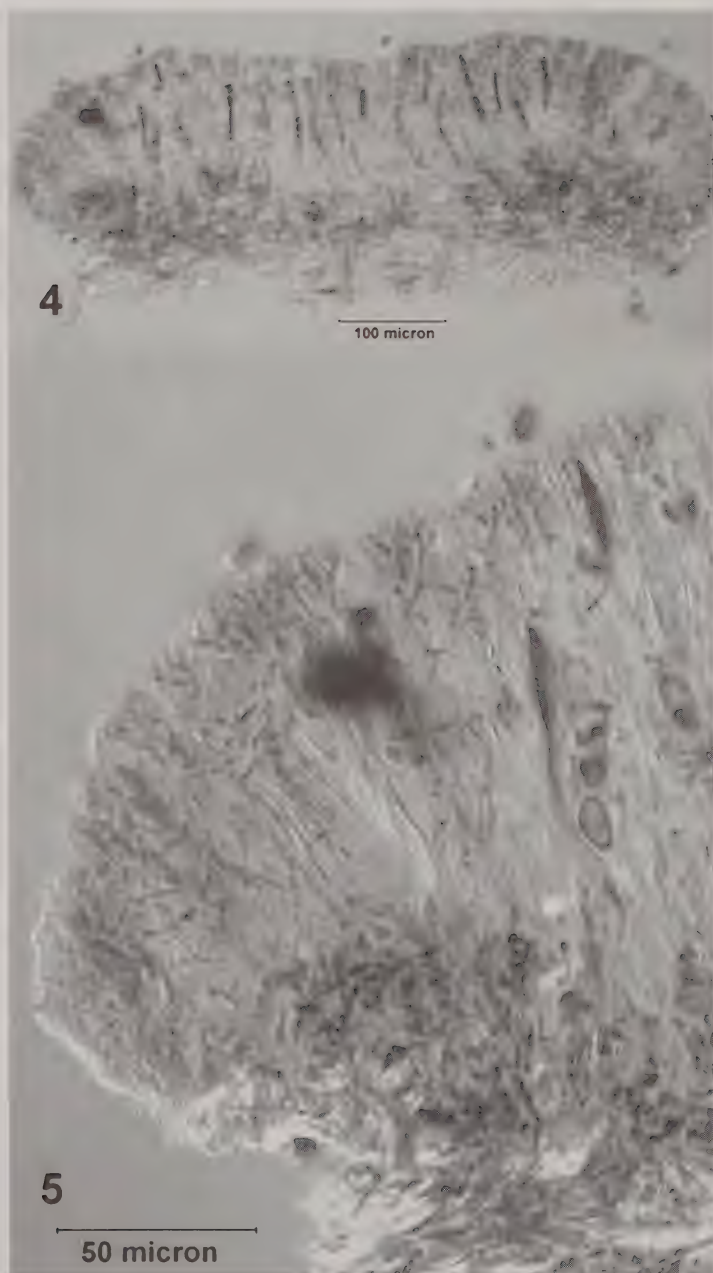
The authors would like to express their deep thanks to Dr. P. M. Kirk, Dr. T. Ahti and Dr. D.L. Hawksworth for consultations, Prof. R. P. Korf and Prof. D. L. Hawksworth for serving as pre-submission reviewers and valuable suggestions, and Ms. X. Song for making sections of fruitbodies. This work was supported by the National Natural Science Foundation of China (nos. 30230020, 30525002).

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Figs. 1–5. Morphology of *Agyrium aurantium* (HMAS 97510). [Figs. 1–3 on facing page]: 1. Ascocarps associated with other fungi on nature substrate, scale bar = 10 mm. 2. Portion of hymenium showing asci with a very thick apex. 3. Portion of hymenium showing ascospores. [Figs. 4–5 on following page, p. 172]: 4. Longitudinal section of an ascocarp. 5. Structure at apothecial margin and branched paraphysis apices in gel matrix.





New species of *Kananascus* and its anamorph from Lithuania

AUŠRA TREIGIENĖ

ausra.t@botanika.lt

Institute of Botany, Laboratory of Mycology
Žaliųjų ežerų 49, LT-08406, Vilnius, Lithuania

Abstract—*Kananascus europaeus* sp. nov. (Sordariomycetes, *Trichosphaeriales*) and its anamorph *Koorchaloma europaea* sp. nov. were recorded on *Acorus calamus*, *Carex panicea*, *Equisetum* sp. and *Scirpus sylvaticus* in Lithuania. Both are described and illustrated.

Key words—Ascomycetes, taxonomy

Introduction

The genus *Kananascus* Nag Raj (Sordariomycetes, *Trichosphaeriales*) was established in 1984 to accommodate two species – *K. verrucisporus* Nag Raj (type species) and *K. koorchalomagnatus* Nag Raj. The genus is characterised by superficial perithecia bearing setae with swollen and often bulbous terminal cells. The anamorph genus *Koorchaloma* Subram. was described in 1953 with the type species *Koorchaloma madreya* Subram. *Koorchaloma* is characterised by sporodochial to acervular setose conidiomata with fusiform conidia that bear mucoid appendages at both ends or only at the apex (Nag Raj 1984, 1993). Until now, nine species have been described for the genus: *Ko. bambusae* Nag Raj, *Ko. dimorpha* Matsush., *Ko. galatae* Kohlm. & Volkm.-Kohlm., *Ko. jamaicensis* Nag Raj, *Ko. madreya* Subram., *Ko. occidentalis* Nag Raj, *Ko. okamurae* Hino & Katum., *Ko. novojournalis* Yanna et al., and *Ko. spartinicola* V.V. Sarma et al. (Hino 1961; Nag Raj 1984, 1993; Yanna et al. 1998; Kohlmeyer & Volkmann-Kohlmeyer 2001; Sarma et al. 2001; Matsushima 2003). All fungi have been reported from Asia (China – Hong Kong, India, Japan) and America (USA, Jamaica).

At the beginning of July, 2001, in eastern Lithuania (Širvintos district) abundant orange conidiomata were observed on dead leaves of *Scirpus sylvaticus*. The fungus was identified as belonging to the genus *Koorchaloma*. Approximately a month later an ascomycete belonging to the genus *Kananascus* was found in the same locality together with this coelomycete. The fungus was most abundant on *Scirpus sylvaticus*. Nearby growing *Acorus calamus* was also slightly colonized by this fungus, but only sparse conidiomata were observed on its leaves. While revisiting the same locality in September, we found neither conidiomata nor perithecia of this fungus on any plants. In 2002 we again failed to find this fungus, yet in early July 2003 the fungus was recorded in western Lithuania (Plungė district) on plants of *Carex panicea* and *Equisetum* sp.

Based on the morphological characters of ascomycetes and coelomycetes, we concluded that this material from Širvintos district refers to *Kananascus* and *Koorchaloma* respectively. Comparative morphological studies of our material with all known representatives of *Kananascus* and *Koorchaloma* revealed that fungi from Širvintos and Plungė districts do not respond to descriptions of other related fungi (Table 1, 2). Therefore, we describe these micromycetes as new species of *Kananascus* and *Koorchaloma*.

Colour of conidiomata was defined according to Kornerup & Wanscher (1978).

Descriptions

Kananascus europaeus Treigienė sp. nov.

Figs. 1, 2

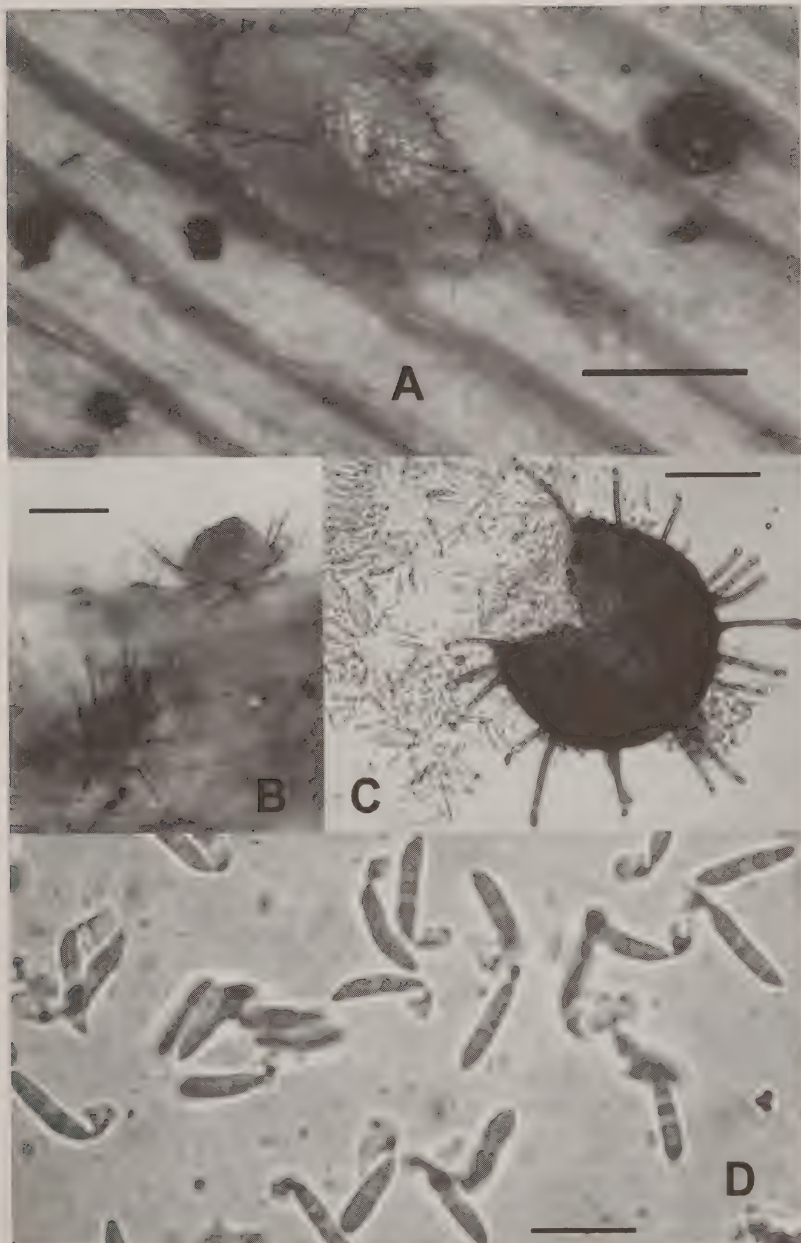
Perithecia discrete, superficialia, globosa, subglobosa vel pyriformia, diametros 90–200 μm , 150–250 μm alta, arida, collabentia, unilocularia, setosa, atrobrunnea, parvo papillatum, ostiolum circulare; canalis apicalis periphysatis; parietula 20–25 μm crassa, extrinsecus composita ex alituot stratis e cellulis pallescentibus et tenuitunicatis textura prismatica. Setae peritheciarii natae circiter mediam partem parietulae, simplices, cylindreae, septatae, brunneae, ad apicem pallidiorae, leves, crassitunicatae 95–125 μm longae, 5–6 μm latae, 9–10 μm latae ad basim, cellula apicis dilatata, globosa vel subglobosa, tunica tenui, subhyalina vel hyalina, ut videtur mucosa, usque 7.5 μm lata, interdum percurrenter crescens. Asci fusiformi, 60–75 $\times$ 8–8.5 μm . Paraphyses nullae. Ascosporae anguste fusiformae, paulum sinuatae, basibus paulum extenuatis et rotundatis, 1-septatae, hyalinae, leves, crasse guttulae, 21.5–25 $\times$ 2.5–3 μm .

HOLOTYPE—LITHUANIA. ŠIRVINTOS DISTRICT, Petriškės village (54°53'N, 25°07'E), on dead leaves of *Scirpus sylvaticus* L. collected 10.VII.2001, A. Treigienė (HOLOTYPE-BILAS 26107, ISOTYPE-LE 212486) (together with *Koorchaloma europaea*).

Etymology: first species of the genus recorded from Europe.

Perithecia discrete, superficial, globose, subglobose or pyriform, 90–200 μm diam., 150–250 μm high, collapsing when dry, unilocular, setose, brownish black, with small papilla, ostiole circular; apical canal periphysate; wall 20–25 μm thick, composed externally of few layers of textura angularis with brown, thick-walled cells and internally of textura prismatica with lighter coloured, thin-walled cells; perithecial setae arising all around the perithecial wall in the median part, simple, cylindrical, septate, dark brown, smooth, thick-walled, 95–125 μm long, 5–6 μm wide, 9–10 μm wide at the base, apex cell enlarged, globose to subglobose, thin-walled, subhyaline to hyaline, appearing mucoid, up to 7.5 μm wide, occasionally with percurrent growth. Asci clavate, 60–75 $\times$ 8–8.5 μm . Paraphyses absent. Ascospores narrow fusiform, slightly bent, ends rounded and slightly narrowing, 1-septate, hyaline, smooth-walled, guttulate, 21.5–25 $\times$ 2.5–3 μm .

Fig. 1. *Kananascus europaeus* (holotype in BILAS 26107). A. Association of teleomorph (at the upper right and the lower corner) and anamorph (in the centre; bar=400 μm); B. Conidiomata (bar=100 μm); C. Ruptured perithecium and asci (bar=50 μm); D. Conidia (bar=15 μm).



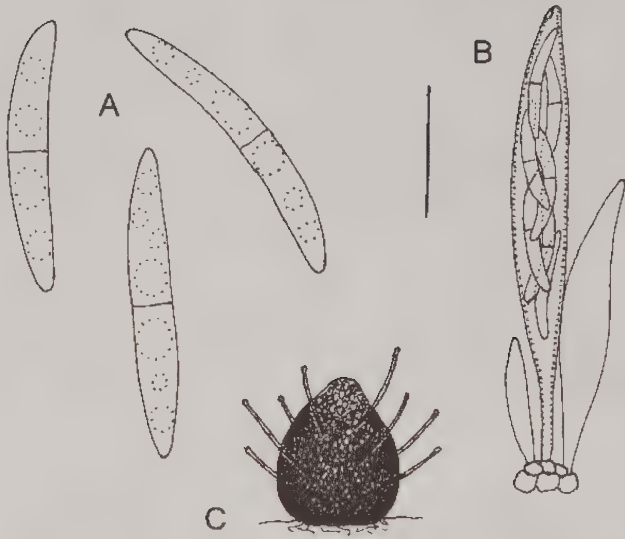


Fig. 2. *Kananascus europaeum* (holotype in BILAS 26107): A. Ascospores (bar=10 µm), B. asci (bar=40 µm), C. perithecium (bar=200 µm).

Table 1. A comparison of morphological characters of *Kananascus europaeus*, *K. verrucisporus* and *K. koorchalomagnatus*

	<i>K. verrucisporus</i>	<i>K. europaeus</i>	<i>K. koorchalomagnatus</i>
Perithecia			
Diam. (µm)	250–300	90–200	160–300
High (µm)	290–320	150–250	180–300
Wall thickness (µm)	20–30	20–25	20–25
Ascus size (µm)	40–65 × 5–10	60–75 × 8–8.5	(40)52–71 × 7–10
Ascospores			
Size (µm)	16–27 × 3–4	21.5–25 × 2.5–3	18–25 × 3.5–4.5
Shape	Fusiform	Narrow fusiform	Fusiform

Koorchaloma europaea Treigienė sp. nov.

Figs. 1, 3

Mycelium superficiale vel in substrato immersum, ramosum, septatum, hyalinum, circa 1.5–2.5 μm latum. Conidiomata stromatica, discreta, dispersa, superficialia, parum crocata, gelatinosa, diameters 100–1100 μm , 95–250 μm alta. Stromata tenue, album. Setae dispositae circum marginem conidiomatis, steriles, solitariae, non-ramosae, plerumque erectae, leves, crassitunicatae, septatae, brunneae, apex pallidior et tenui tunica, rondsos sive tumidosus usque 10 μm latus interdum percurrenter crescens; nonnulli apices cum vagina muscilagina diam. circa 15 μm . Setae conidiomatis multiseptatae, circa 105–520 μm longae, 5–7.5 μm latae, ad basim 7.5–15 μm latae. Setae substratae tantum 2–4 septatae, plerumque breves, nonnullae usque 72 μm latae. Conidiophora macronematosa, in sporodochialibus composita, erecta, ramosa ad basim, tenuitunicata, levia, hyalina, usque 40 μm longae et 2.5 μm latae, interdum reducata ad cellulae conidiogenae. Cellulae conidiogenae monoblasticae, discretae, terminales, subcylindricae, saepe in apice tumidosae, cum parvo collario, leves, hyalinae, 15–35 $\times$ 1.8–3 μm . Conidia unicellulata, naviculata, rarius anguste fusiformia, in apice erecta sive paulum sinuata, hyalina, guttulate, 10–17.5 $\times$ 2–2.5 μm , in apice cum adimento choanaformio gelatinosa, basi truncata.

HOLOTYPE—LITHUANIA, ŠIRVINTOS DISTRICT, Petriškės village (54°53'N, 25°07'E), on dead leaves of *Scirpus sylvaticus* L. collected 10.VII.2001, A. Treigienė (**HOLOTYPE**-BILAS 26107, **ISOTYPE**-LE 212486) (together with *Kananascus europaeus*).

Mycelium superficial or immersed in the substratum, composed of branched, septate, smooth, hyaline hyphae, 1.5–2.5 μm wide. Conidiomata stromatic, scattered, superficial, light orange, gelatinous, 100–1100 diam., 95–250 μm high. Stromata thin, white. Setae situated along the edges of conidiomata and dispersed on substrate (scattered or in short rows), sterile, unbranched, erect or variously bent, smooth, thick-walled, septate, brown, paler towards the apex, apex thin-walled, rounded or swollen up to 10 μm wide with occasional percurrent growth; some apices with yellow, up to 15 μm diam. gelatinous sheaths. Conidiomatal setae multiseptate, up to 105–520 μm long, 5–7.5 μm wide, swollen at the base which is 7.5–15 μm wide. Setae which are visible on the surface of substrate are developing on hyphae which are expanding in plant tissue from stroma in all directions around; they are 2–4-septate, up to 72 μm long. Conidiophores macronematous, compacted in the sporodochium, erect, branched at the base, thin-walled, smooth, hyaline, up to 40 μm long and up to 2.5 μm wide, some reduced to conidiogenous cells. Conidiogenous cells monoblastic, discrete, subcylindrical, often somewhat swollen at the apex, with flared collarettes, smooth, hyaline, 15–35 $\times$ 1.8–3 μm . Conidia 10–17.5 $\times$ 2–2.5 μm , unicellular, guttulate, naviculate, rarely narrow fusiform, apex straight or slightly bent, bearing a funnel-shaped, mucoid, apical appendage, base truncate.

OTHER SPECIMENS EXAMINED—On dead leaves of *Scirpus sylvaticus*, LITHUANIA, Širvintos district, Petriškės village (54°53'N, 25°07'E), 7.VII.2001, A. Treigienė, BILAS 26108; on dead leaves of *Acorus calamus* L., LITHUANIA, Širvintos district, Petriškės village (54°53'N, 25°07'E), 15.VIII.2001, A. Treigienė, BILAS 26109; on dead leaves of *Carex panicea* L., LITHUANIA, Plungė district, environs of Plateliai (56°02'N, 21°46'E), 2.VII.2003, A. Treigienė, BILAS 26963; on dead stem of *Equisetum* sp., LITHUANIA, Plungė district, environs of Plateliai (56°02'N, 21°46'E), 2.VII.2003, A. Treigienė, BILAS 26964.

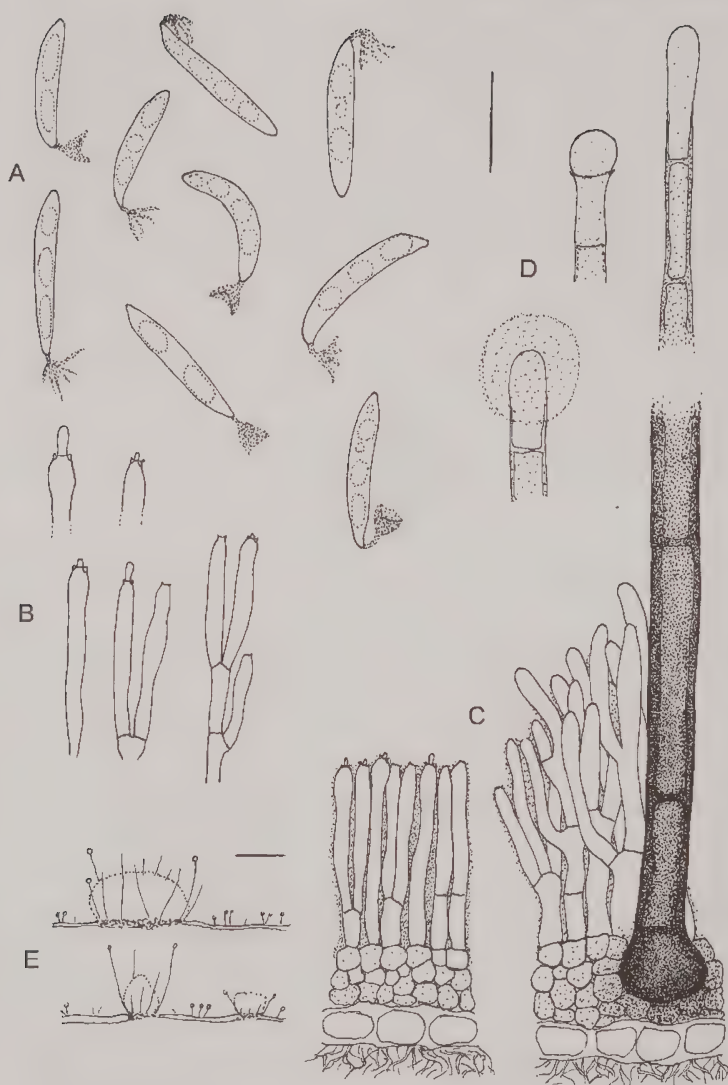


Fig. 3. *Koorchaloma europaea* (holotype BILAS 26107): A. Conidia and B. conidiophores (bar=10 µm); C. basal stroma, excipular elements and setae. D. apical cells of setae (one with an oil drop) (bar=20 µm); E. habit sketch showing approximate conidiomata and setae (bar=100 µm).

Comments—*Kananascus europaeus* differs from the known *K. koorchalomagnatus* (anamorph – *Koorchaloma madreeya*) and *K. verrucisporus* (anamorph – *Koorchaloma jamaicensis*) by ascospore shape and size. The synopsis of characteristics of these three similar species of *Kananascus* is given in Table 1. According to morphological characters, Lithuanian specimens of *Koorchaloma europaea* occupy an intermediate position between *Ko. jamaicensis* and *Ko. madreeya*. Naviculate conidia of *Ko. europaea* are similar to these of *Ko. jamaicensis* but conidia of the latter species bear mucoid appendages at both ends (at one end in *Ko. europaea*). Moreover, conidiophores of *Ko. jamaicensis* are reduced to conidiogenous cells. The new species is closest to *Ko. madreeya* in the structure of conidiomata, but mainly differs by the form of conidia (Table 2).

Table 2. A comparison of morphological characters of *Koorchaloma europaea*, *Ko. jamaicensis* and *Ko. madreeya*

	<i>Ko. jamaicensis</i>	<i>Ko. europaea</i>	<i>Ko. madreeya</i>
Conidiomata Diam. (µm) Colour	120–320 Salmon to flesh	100–1100 Light orange	200–600 Salmon to orange
Setae Length (µm) Width at base (µm) Width at apex (µm) Swollen at apex	80–170 13–15 3–7 –	105–520 7.5–15 5–10 +/-	100–350 8–12 4–6 +
Size of conidiogenous cells (µm)	6–11(12) × 2.5–3	15–35 × 1.8–3	11–20 × 3–4
Conidiophores reduced to conidiogenous cells	+	+/-	–
Conidia Size Shape Appendages apical basal	12–19 × 2.5–3.5 Naviculate, fusiform + +	10–17.5 × 2–2.5 Naviculate, narrow fusiform + –	11–17 × 3–4.5 Fusiform + –

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The genus *Chlorophyllum* (Basidiomycetes) in China

Z. W. GE^{1,2} & ZHU L. YANG^{1,*}

zwge@mail.kib.ac.cn fungi@mail.kib.ac.cn

¹ Laboratory of Biodiversity and Biogeography, Kunming Institute of Botany
Chinese Academy of Sciences, Heilongtan, Kunming 650204, Yunnan, P. R. China

² Graduate School of the Chinese Academy of Sciences
Beijing 100039, P. R. China

Abstract—Species of the genus *Chlorophyllum* (Agaricaceae) in China are described and illustrated with line drawings. Among them, *C. sphaerosporum* is new to science, and *C. hortense* is new to China. A key to the *Chlorophyllum* species in China is also provided.

Key words—Agaricales, new taxon, new record, taxonomy, distribution

Introduction

The genus *Chlorophyllum* Masee (Agaricaceae, Agaricales, Basidiomycetes) in its amended sense is characterized by a hymenidermal pileus covering, a smooth stipe, and basidiospores without a germ pore or with a germ pore but just caused by a depression in the episporium. A hyaline covering on the germ pore is absent. The basidiospores may be white, green, brownish or brown in deposit, and the habit varies from agaricoid to secotioid (Vellinga 2001, 2002, 2003a, b; Vellinga & de Kok 2002; Vellinga et al. 2003). During our survey of the lepiotoid fungi in China, several species were identified, and one new species of the genus was encountered and thus described below. Differences between similar species are provided and discussed.

Material and methods

All material examined collected in China, and deposited in three Herbaria. Herbarium codes used follow Holmgren et al. (1990) with one exception: HKAS = Herbarium of Cryptogams, Kunming Institute of Botany, Chinese Academy of Sciences, which is not listed in the index or relevant publications. The descriptions of species will appear in alphabetical order by species epithet. In the description, macro-morphology is based on the field notes and color slides of the material; micro-morphology is based on observation of the material under microscope. In the descriptions of basidiospores, the abbreviation [*n/m/p*] shall mean *n* basidiospores measured from *m* fruit bodies of *p* collections in 5% KOH solution; Q is used to mean “length/width ratio” of a spore in

* Corresponding author

side view; Q means average Q of all basidiospores $\pm$ sample standard deviation; x means range of basidiospore length $\times$ width.

Taxonomy

1. *Chlorophyllum agaricoides* (Czern.) Vellinga, Mycotaxon 83: 416, 2002 **FIGURE 1**
Endoptychum agaricoides Czern., Bull. Soc. Imp. nat. Moscou 18 (2): 148, 1845; *Secotium*
agaricoides (Czern.) Hollós, Természettajzi Füzetek 25: 93, 1902.

Fruit bodies (Fig. 1a) secotioid, 5-8 cm high, 3-7 cm across, cordate to obtusely conical, usually broader toward base; margin appressed to the stipe, usually lacerated when mature. **Peridium** 1-3 mm thick, fleshy and tender when young, becoming rather tough and fibrous upon drying; surface white, becoming straw colored on maturing and drying, covered with brownish to brown squamules. **Gleba** white when young, becoming yellow and finally brown; gleba chambers somewhat labyrinthiform, varying in width, up to 1 mm; tramal plates persisting in the mature and dried specimens, forming lamella-like folds; columella present, white, becoming reddish when bruised. **Stipe** short, 1-2 $\times$ 0.8-1.5 cm, sub-conical, tapering downward into a thick cord, whitish, becoming yellowish on maturing.

Basidia 7-11.5 μm in diam., clavate, 4-spored. **Basidiospores** (Fig. 1b) [45/3/3] 7.5-8.5 (9.5) $\times$ 6.0-7.0 (8.0) μm ($x = 8.3 \pm 0.41 \times 7.0 \pm 0.31 \mu\text{m}$), $Q = 1.13$ -1.21 (1.25) ($Q = 1.18 \pm 0.04$), orthotropic, statismosporic, subglobose to broadly ellipsoid, rarely ovoid, yellowish brown to greenish brown, smooth, thick-walled, but becoming thinner towards the apex which is often slightly depressed; hilar appendix small but usually attached to a thin-walled sterigmal appendage; young basidiospores dextrinoid, metachromatic in cresyl blue, becoming reddish in Congo Red. Clamps not observed in all tissues.

Habitat and known distribution in China: Solitary; scattered, or in groups on lawns and pastures, sometimes also on the ground in forest. Terrestrial; distributed in Inner Mongolia.



Fig. 1. *Chlorophyllum agaricoides* (HKAS 4408).
 a. Fruit bodies. b. Basidiospores.

Material examined: China, Inner Mongolia, 15 Sept. 1978, Z. Y. Li & J. Z. Li 1465 (HKAS4408); Baotou City, 3 Aug. 1988, P. G. Liu 307 (HKAS 21432), alt. 1630 m; 31 Aug. 1988, P. G. Liu 260 (HKAS 21430a), P. G. Liu 571 (HKAS 21431), alt. 2100 m; Wumeng county, 2 Aug. 1990, P. G. Liu 627 (HKAS 23034), alt. 1590 m.

Note: *Chlorophyllum agaricoides* is characterized by its secotioid habit, labyrinthiform to sublammellate gleba, and yellowish brown to greenish brown, statismosporic, orthotropic, subglobose to broadly ellipsoid basidiospores with a slightly depressed apex. It has been formerly recorded as *Endoptychum agaricoides* from Inner Mongolia and Hebei Province of China by Liu (1984, 2005).

2. *Chlorophyllum hortense* (Murrill) Vellinga, Mycotaxon 83: 416, 2002 FIGURE 2

Lepiota hortensis Murrill, N. Amer. Fl. 10 (1): 59, 1914; *Leucoagaricus hortensis* (Murrill)

Pegler, Kew Bull. Add. Ser. 9: 414, 1983.

Fruit bodies (Fig. 2a) agaricoid, small to medium. **Pileus** 4-7 cm in diam., convex, distinctly umbonate, white to cream-colored, covered with small patches of pale ochreous to yellowish brown squamules, margin of pileus finely short striate when dried. **Lamellae** free, crowded, whitish, becoming dirty white to pale ochreous, but never becoming darker when dried. **Stipe** 6-8 × 0.5-1 cm, subcylindrical, fibrillose, white to whitish, base not enlarged. **Annulus** present, persistent. **Context** white, becoming reddish when cut.

Basidia (Fig. 2e) 20-30 (32) × 7.5- 8.5(10.0) µm, clavate to narrowly clavate, hyaline, mostly 2-spored, occasionally 4-spored; sterigmata 3-5 µm long; clamps not observed on basal septa. **Basidiospores** (Fig. 2c) [85/5/2] (8.0) 8.5-10.0 (11.5) × (5.5) 6.0-7.0 (8.0) µm ($x = 9.0 \pm 0.61 \times 6.4 \pm 0.43$ µm), $Q = (1.23) 1.31-1.50 (1.57)$ ($Q = 1.42 \pm 0.06$), ellipsoid, sometimes broadly ellipsoid, thick walled, smooth, without germ pore, dextrinoid, metachromatic in cresyl blue, not or becoming reddish in Congo Red. **Pleurocystidia** absent. **Cheilocystidia** (Fig. 2d) (23) 30-40 (50) × (6) 8-10 (12) µm, crowded, forming a sterile edge, narrowly clavate to subcylindrical often with a round apex 6-8 µm, thin-walled, often with yellowish to brownish vacuolar pigments. **Pileipellis** (pileal squamules) (Fig. 2b) a hymeniderm made up of broadly clavate, sometimes subfusiform, colorless or nearly colorless, slightly thick walled (≤ 0.5 µm) terminal elements. **Stipitipellis** hardly differentiated, without caulocystidia, composed of filamentous hyphae with many anastomosing structures.

Habitat and known distribution in China: Solitary; Terrestrial; distributed in Guangdong and Yunnan Provinces. New to China.

Material examined: China, Guangdong Prov., Lianshan, 11 Sept. 1985, G. Y. Zheng 9175 (GDGM 9175, as *Chamaeota dextrinoidespora* by Bi & Li 1988), alt. 700-800 m. Yunnan Prov., Kunming, 21 Sept. 1991, Z. L. Yang 1709 (HKAS 23623), alt. 1900 m.

Note: The characters of the collections cited above agree well with the original and related descriptions (e.g. Akers & Sundberg 1997; Pegler 1983; Vellinga 2003a). Clamps in the Chinese collections were not observed, while Vellinga (2003a) stated that *C. hortense* is provided with clamps, and Akers & Sundberg (1997) found the clamps in the stipitipellis. Our observations show that there are many anastomosing structures on the hyphae of stipitipellis, which may be misinterpreted as clamps when they are on or near septa.

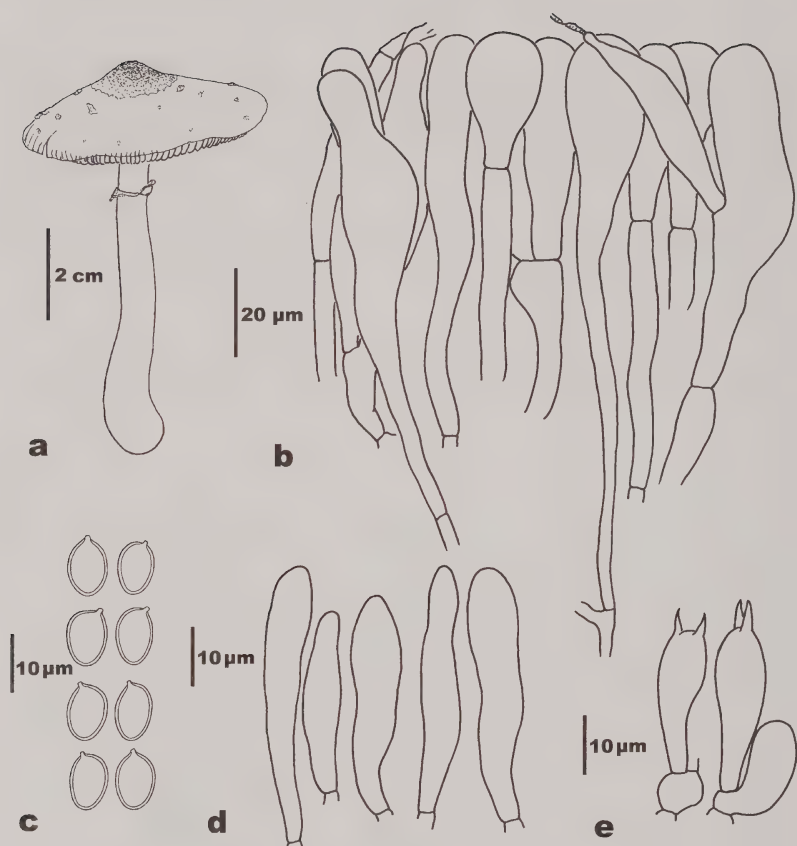


Fig. 2. *Chlorophyllum hortense* (GDGM 9175).
 a. Fruit bodies. b. Pileipellis (squamules on pileus).
 c. Basidiospores. d. Cheilocystidia. e. Basidia.

GDGM 9175 was previously regarded as *Chamaeota dextrinoidespora* Z.S. Bi (Bi & Li 1988). Reexamination of the type of *C. dextrinoidespora* shows that it bears basidiospores [(8.0) 8.5–11.5 (12) × (6.0) 6.5–8.5 µm] with a distinct germ pore, clavate to fusiform cheilocystidia (11–18 µm in diam.) often with a papilla or rostrate apical appendages; and a trichodermial pileipellis of narrowly clavate to subfusiform, sometimes lanceolate cells (13–20 µm in diam.) often with a rostrate apical appendage (data of authors unpublished).

3. *Chlorophyllum molybdites* (G. Mey.: Fr.) Masee, Kew Bull. 1898: 136, 1898

FIGURE 3

Agaricus molybdites G. Mey., Pr. Fl. Essequ.: 300, 1818: Fr., Syst. Mycol. 1: 308, 1821;
Mastocephalus molybdites (G. Mey.: Fr.) Kuntze, Rev. Gen. Pl. 2: 860, 1891; *Lepiota*
molybdites (G. Mey.: Fr.) Sacc., Syll. Fung. 5: 30, 1887; *Leucocoprinus molybdites* (G.
 Mey.: Fr.) Pat., Bull. Soc. Mycol. Fr. 29: 215, 1913; *Macrolepiota molybdites* (G. Mey.:
 Fr.) G. Moreno, Bañares & Heykoop, Mycotaxon 55: 467, 1995.

Fruit bodies (Fig. 3a) agaricoid, medium to large. **Pileus** 8-17 cm in width, nearly hemispherical when young, becoming convex to plano-convex with age, sometimes with a low umbo at disc, white to whitish, covered with brown squamules; disc smooth, brown. **Lamellae** free, crowded, whitish when young, then greenish to green when mature, bluish green to grayish green when dried. **Stipe** whitish, subcylindrical, 18 × 0.8-1.2 (1.5) cm, widening downwards, base enlarged. **Annulus** well developed, ascending, double crowned, upper surface whitish, lower surface brownish. **Context** whitish, becoming reddish brown when cut.

Basidiospores (Fig. 3c) [40/2/2] (8.5) 9.0-10.0 (10.5) × 6.5-8.0 μm ($x = 9.54 \pm 0.44 \times 7.18 \pm 0.37 \mu\text{m}$), $Q = (1.25) 1.27-1.43$ ($Q = 1.33 \pm 0.06$), broadly amygdaliform, thick-walled, smooth, light olive-green, dextrinoid, with a germ pore caused by a depression in the epispodium on the truncate apex. **Basidia** (Fig. 3e) 27-36 × (9.5) 11-14 (16) μm, clavate, hyaline, 4-spored; sterigmata 3-4.5 μm long. **Pleurocystidia** absent. **Cheilocystidia** (Fig. 3d) numerous, broadly clavate to sphaeropedunculate, 21-40 × (9) 13-21 μm, with brownish vacuolar pigment. **Pileipellis** (Fig. 3b) a palisade of hyphae with terminal elements clavate to subfusiform, 8-16 μm in diam., with brown to dark brown vacuolar pigment.

Habitat and known distribution in China: Terrestrial to saprotrophic; scattered to gregarious on the ground in broadleaf forest. Distributed in Guangdong, Hainan, Hunan, Sichuan and Yunnan.

Material examined: China, Guangdong Prov., Renhua, 1 Aug. 1985, A. H. Huang & G. Y. Zheng 9131 (GDGM 9131, as *Macrolepiota rachodes* by Bi et al. 1990, 1994); Baoting, 20 May 1988, T. H. Li 13868 (GDGM 13868, as *Macrolepiota rachodes* by Bi et al. 1997). Hainan Prov., Haikou, 20 Aug. 1994, X. L. Wu 7 (HKAS 29348); Qionghang, 2 Jun. 1988, GDGM 14911 (as *Macrolepiota rachodes* by Bi et al. 1997). Hunan Prov., Hengyang, 21 Jun. 2004, Z. H. Chen 30237 (HKAS 45051). Sichuan Prov., Xichang, 30 Jun. 1978, L. W. Xu 8 (HMAS 42516, as *Lepiota rachodes* by Ying et al. 1994), E 102.16, N 27.54. Yunnan Prov., Yuanmou, 4 July 2005, L. S. Wang 05-24866 (HKAS 49418).

Note: The Chinese specimens match closely with other descriptions of *C. molybdites* (e.g. Reid & Eicker 1991, Vellinga 2001). This species, often causing gastro-intestinal problems (e.g. Reid & Eicker 1991), was previously misidentified as *Macrolepiota rachodes* in some Chinese mycological literature (e.g. Bi et al. 1990, 1994, 1997). But the bluish green lamellae, the well developed complex annulus, the whitish context becoming reddish brown when cut, the greenish, broadly amygdaliform basidiospores with a truncate apex, and the broadly clavate to sphaero-pedunculate cheilocystidia clearly characterize the species.

Chlorolepiota mahabaleshwarsensis Sathe & S.D. Deshp. is similar to *C. molybdites* on account of the greenish basidiospores. However, the basidiospores of the former are not

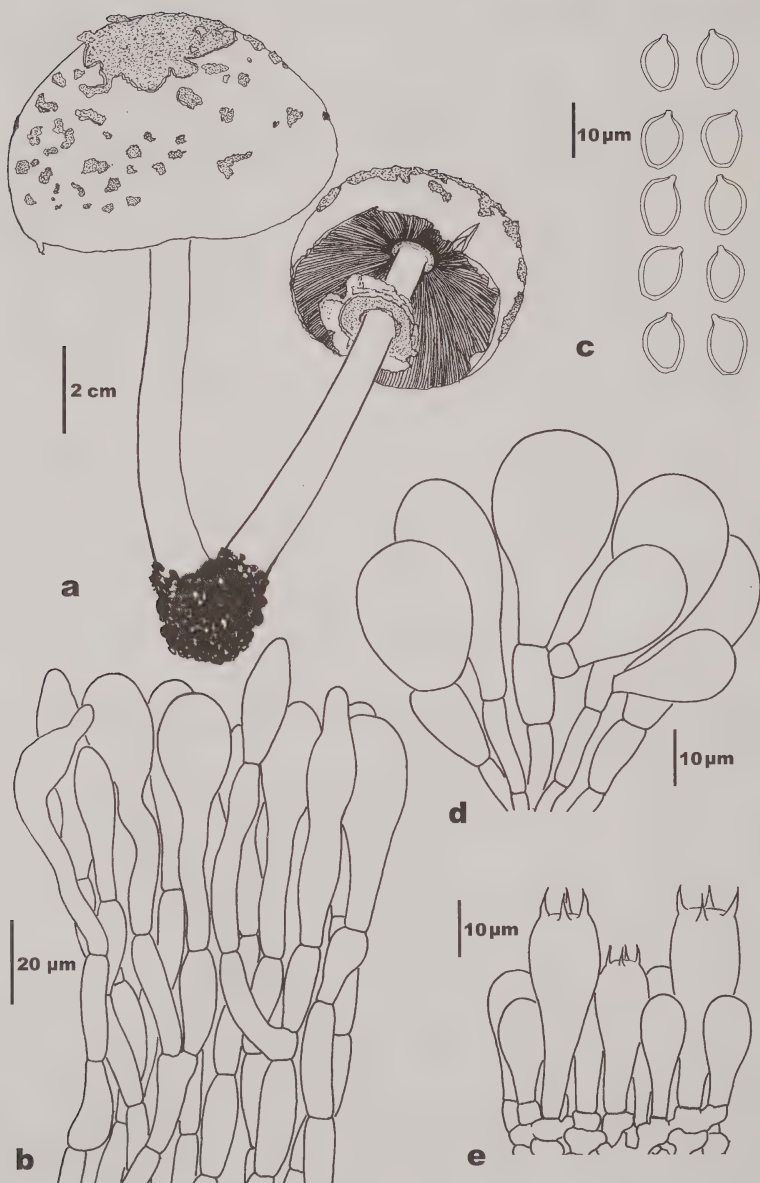


Fig. 3. *Chlorophyllum molybdites* (HKAS 45051).

a. Fruit bodies. b. Pileipellis. c. Basidiospores. d. Cheilocystidia. e. Basidia..

truncated, and bear a rudimentary germ pore with a poral plug (Sathe & Deshpande 1979).

4. *Chlorophyllum sphaerosporum* Z. W. Ge & Zhu L. Yang, sp. nov.

FIGURE 4

Pileus 4.5-6.5 cm *latus*, *convexus*, *albus vel albidus*, *squamulis luteo-brunneis vel rubeolis brunneis*, *obtusius umbonatus*. *Lamellae liberae*, *albae*. *Stipes* 4.0-7.0 × 0.5-0.7 cm, *subcylindricus*, *subaequalis vel sursum attenuatus*, *albidus*, *non-discolorans*, *basis incrassatus*. *Annulus membranaceus*, *albidus*. *Caro alba*. *Basidia* 24-32 × 9.5-12.5 µm, *clavata*, *hyalina*, *4-sporigera*. *Basidiosporae* (8.0) 9.0-10.0 (11.0) × 7.0-9.0 (9.5) µm, *subgloboseae vel lato-ellipsoideae*, *hyalinae*, *aporiae*, *dextrinoideae*, *congolophilosae*, *metachromaticae*. *Pleurocystidia absentia*. *Cheilocystidia clavata vel latoclavata*, *hyalina*, (18) 25-32 (40) × (9) 11-13.5 µm. *Squamulae pilei hymenidermae*, *apicalis hyphis pallide brunneis clavatis*. *Fibulae praesentes*. *Habitatio: terrestris*.

Holotypus: "Mao Xiao-Lan M8040 (HMAS 66153), 15 August 1994, Inner Mongolia, China".

Etymology: the epithet refers to the shape of the basidiospores.

Fruit bodies (Fig. 3a) agaricoid, small to moderate. **Pileus** 4.5-6.5 cm in diam., convex, with a low umbo at the disc; surface white to whitish, covered with yellow brown to reddish brown squamules, continuous on disc, elsewhere disrupted; margin with faint short striations. **Lamellae** free, crowded, white, off-white to cream when dried. **Stipe** central, 4.0-7.0 × 0.5-0.7 cm, subcylindrical, slightly attenuate upward, surface whitish, not changing color when bruised, enlarged at the base. **Annulus** membranous, whitish, movable, compound. **Context** white, unchanging; taste mild.

Basidia (Fig. 4e) 24-32 × 9.5-12.5 µm, clavate, hyaline, thin-walled, 4-spored, occasionally 2-spored; sterigmata up to 4.5 µm long. **Basidiospores** (Fig. 4c) [105/6/2] (8.0) 9.0-10.0 (11.0) × 7.0-9.0 (9.5) µm ($\bar{x} = 9.1 \pm 0.50 \times 8.0 \pm 0.51$ µm), $Q = (1.00) 1.12-1.21$ ($Q = 1.14 \pm 0.04$), subglobose, sometimes broadly ellipsoid, smooth, hyaline, thick-walled (about 0.5 µm thick), without germ pore, dextrinoid, congophilous, metachromatic in cresyl blue; apiculus 1-1.5 µm long. **Pleurocystidia** absent. **Cheilocystidia** (Fig. 4d) (18) 25-32 (40) × (9) 11-13.5 µm, clavate to broadly clavate, hyaline to very pale yellowish, thin-walled. **Lamellar trama** subregular to irregular, composed of colorless hyphae (2.5) 5-10 (12) µm in width. **Pileipellis** (Fig. 4b) a hymenidermal layer composed of brownish, slightly thick-walled, clavate to broadly clavate terminal elements 38-53 (80) × 12-25 (31) µm. **Clamp connections** occasionally observed at the base of young basidia and cheilocystidia.

Habitat and known distribution: Terrestrial in forests dominated by *Keteleeria* and *Xanthoceras*, so far only known from Inner Mongolia, China.

Additional material examined: China, Inner Mongolia, Qasuqi, 10 Aug. 1988, P. G. Liu 313b (HKAS 21185b), alt. 1200 m.

Note: *Chlorophyllum sphaerosporum* is characterized by its small, thick-walled, subglobose basidiospores without a germ pore, the unchanging context, and the hymenidermal pileipellis composed of brownish, slightly thick-walled clavate terminal elements. Based on these characters, especially the small subglobose basidiospores without a

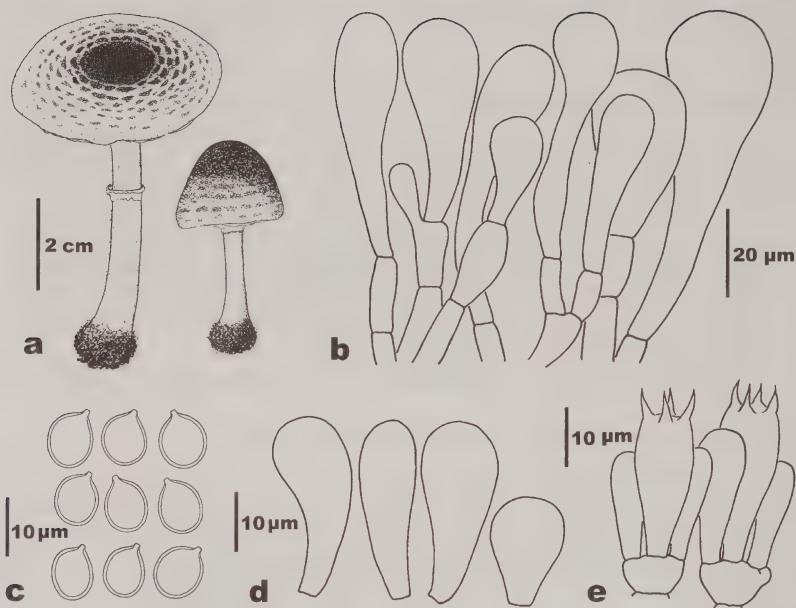


Fig. 4. *Chlorophyllum sphaerosporum* (from holotype).

- a. Fruit bodies. b. Pileipellis (squamules on pileus).
c. Basidiospores. d. Cheilocystidia. e. Basidia.

germ pore, *C. sphaerosporum* can be easily keyed out in the genus *Chlorophyllum*. The present species is similar to *Chlorophyllum hortense*, in bearing basidiospores without a germ pore. However, *C. hortense* has 2-spored basidia, ellipsoid to broadly ellipsoid basidiospores, narrowly clavate to subcylindrical cheilocystidia, and the whitish context of the stipe becoming reddish when damaged (Akers & Sundberg 1997; Vellinga 2003a; see above).

Chlorophyllum sphaerosporum is also similar to *C. shimogaense* Sathe & S.M. Kulk. on account of the subglobose basidiospores. However, the latter, originally described from Shimoga, southwestern Indian, has much larger fruit bodies (pileus 8–10.5 cm in diam., stipe 13.5–15 × 0.7–7.1 cm) with a trichodermal palisade of much narrower hyphae (4.5–10.5 µm in diam.) in the pileal squamules, and possesses no clamp connections (Sathe et al. 1981). The basidiospores of *C. shimogaense* were described as having “indistinct germ pore or without germ pore”. *Chlorophyllum sphaerosporum* seems to be also similar to *C. bharatense* Sathe & S.M. Kulk.. However, the latter, originally described from India, has a trichodermal palisade with much narrower terminal cells (43–108 × 11–13.5 µm) in the squamules on the pileus, and cream lamellae becoming reddish brown when dried, and no clamps. The basidiospores of *C. bharatense* were described as “without germ pore or with indistinct germ pore (Sathe et al. 1981). Type collections of the Indian species were requested twice on loan for comparison, but no response was received.

Taxon with uncertainty recorded from China

Chlorophyllum rachodes (Vittad.) Vellinga, Mycotaxon 83: 416, 2002

Agaricus rachodes Vittad., Descr. Funghi mang. Italia: 158, 1883 ('1835'); *Lepiota rachodes* (Vittad.) Quél., Mém. Soc. Émul. Montbéliard. Sér. II, 5: 70, 1872; *Leucocoprinus rachodes* (Vittad.) Pat., Ess. Tax. Hym.: 171, 1900; *Lepiotophyllum rachodes* (Vittad.) Locq., Bull. Mens. Soc. Linn. Lyon 11: 40, 1942 (as '*L. rhacodes*'); *Macrolepiota rachodes* (Vittad.) Singer, Lilloa 22: 417, 1951 ('1949').

Note: Macroscopically, *C. rachodes* is characterized by big fleshy fruit bodies, contrasting plate-like squamules on the pileus, a double-crowned annulus, and a bulbous stipe base. The stipe surface becomes orange-red first, then light brown when bruised. Microscopically, it is characterized by the ellipsoid spores with a germ pore caused by a depression in the episprium on the truncate to round apex, and the sphaeropedunculate to broadly clavate cheilocystidia (Candusso & Lanzoni 1990; Vellinga 2003b).

C. rachodes was previously recorded in China (as *Lepiota rachodes* or *Macrolepiota rachodes*) (Bi et al. 1990, 1994, 1997; Zang et al. 1996; Wang & Zang 1983; Mao, 1995; Ying & Zang 1994; Ying et al. 1994). However, according to our re-examination of the vouchers cited in the literature, some of the collections are *C. molybdites* (see above), while GDGM 11851 is *Macrolepiota procera* (Scop.: Fr.) Singer, and HKAS 5299, HMAS 30376 and 30499 are *Leucoagaricus nymphaeum* (Kalchbr.) Bon; HKAS 13214 is *Lepiota clypeolaria* (Bull.: Fr.) P. Kumm. HKAS 5630 consists of only one immature fruit-body, and looks like *M. procera*. HKAS 11749 can not be traced in the Herbarium. Thus, whether *C. rachodes* indeed occurs in China remains uncertain. For the convenience of use, this species is included in the following key.

Key to the *Chlorophyllum* species in China

- 1 Fruit bodies agaricoid, hymenophore lamellate, basidiospores heterotropic, ballistosporic, ellipsoid, subglobose to broadly amygdaliform, without sterigmal appendage 2
- 1 Fruit bodies secotoid, hymenophore (gleba) labyrinthiform to sub-lamellate, basidiospores orthotropic, statismosporic, broadly ellipsoid to subglobose, often with a short sterigmal appendage *C. agaricoides*
- 2 Fruit bodies small to large; lamellae white or brownish with age; spore print white or off-white, never green 3
- 2 Fruit bodies large; lamellae becoming greenish when mature; spore print green *C. molybdites*
- 3 Pileus and stipe discolored reddish or light brown when bruised or cut; basidiospores ellipsoid to broadly ellipsoid or broadly amygdaliform, with or without a germ pore 4
- 3 Pileus and stipe not changing color when bruised or cut; basidia 4-spored, basidiospores subglobose, without a germ pore *C. sphaerosporum*

- 4 Pileus with pale ochreous to yellowish brown patch-like squamules; stipe becoming reddish when bruised; annulus simple; stipe base without a bulb; basidia 2-spored, basidiospores without a germ pore, apex not truncate; cheilocystidia narrowly clavate to subcylindrical *C. hortense*
- 4 Pileus with brown plate-like squamules; stipe becoming light brown when bruised; annulus double crowned; stipe base bulbous; basidiospores with a germ pore caused by a depression in the episprium on the truncate to round apex; cheilocystidia clavate, broadly clavate to sphaeropedunculate *C. rachodes*

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Trechispora elongata species nova from North Europe

OTTO MIETTINEN¹ & KARL-HENRIK LARSSON²

¹ Finnish Museum of Natural History, Botanical Museum
P.O.Box 7, FI-00014 University of Helsinki, Finland
otto.miettinen@helsinki.fi

² Göteborg University, Botanical Institute
P.O. Box 461, SE-40530 Göteborg, Sweden
karl-henrik.larsson@botany.gu.se

Abstract—*Trechispora elongata* (corticoid fungi, Basidiomycota) is described as new. It is reported from Finland, Norway, Poland and Sweden. Morphologically it belongs to the corticoid *Trechispora farinacea* group and is characterised by elongated spores and an anamorph.

Key words—Corticaceae, taxonomy

Introduction

The genus *Trechispora* P. Karst. (Basidiomycetes) with corticoid and poroid species has received attention from several authors in the latest decades. A thorough revision was made by Liberta (1973) and more recently by Larsson (1992, 1995). Still, new species can be encountered even in the relatively well-studied area of Northern Europe. The new species described here belongs to the taxonomically difficult group of species close to *T. farinacea* (Pers. : Fr.) Liberta. The earliest specimen was first collected by John Eriksson 50 years ago and other mycologists have since collected it. After recent collections and Larsson's (1995) revision of the *T. farinacea* group, it has become possible to describe the species.

Materials and methods

The following mounting media were used when studying the specimens in the microscope: 1) Cotton Blue (CB): 0.1 g aniline blue (Merck 1275) dissolved in 60 g pure lactic acid; 2) Melzer's reagent (IKI): 1.5 g potassium iodine (KI) with 0.5 g crystalline iodine (I) and 22 g chloral hydrate dissolved in 20 ml aq. dist; 3) Potassium hydroxide (KOH): 2.5 g potassium hydroxide dissolved in 50 ml aq. dist. Cyanophilous reaction is abbreviated CB+, acyanophilous CB–, negative colour reaction in Melzer's reagent IKI–. When hyphae remain more or less unchanged in potassium hydroxide the note KOH– is used. All the drawings and measurements were made in CB.

Spores and basidia were measured with a 0.1 µm accuracy using magnification ×1000 and phase contrast illumination. The following abbreviations are used when reporting

spore or basidium size: L = mean length; W = mean width; Q = L/W; Q' = variation in quotient of spore length and width of individual spores; n = a/b, where a represents the number of spores measured from b specimens (if b is omitted, all spores are from the same specimen). When reporting spore and basidium size variations, the overall variation is written in parentheses. In size variation figures without parentheses, the extreme 5% ends of variation have been excluded. Whenever the figures within and outside parentheses are identical, parentheses are omitted.

All specimens studied here are deposited in the herbaria GB, H, and TAA.

Species description

Trechispora elongata Miettinen & K. H. Larss. sp. nov.

Fig. 1

Basidioma resupinatum, arachnoideum vel byssoideum, tenue, hymenio laevigato. Systema hypharum monomiticum, hyphae exiles, tenuitunicatae. Conidia praesentia vel absentia, cyanophilia, crassitunicata, ex fragmentatione hypharum oriunda, 3.6–6.6×2.6–4.2 µm. Basidiosporae aculeatae, anguste ellipsoideae, plus minusve arcuatae, 3.7–5×2.1–2.8 µm.

HOLOTYPE—Finland. Pohjois-Häme: Jyväskylä rural municipality, Vuoritsalo, on *Populus tremula*, 5.VIII.2002 O. Miettinen 6605 (H).

ETYMOLOGY—Latin word *elongata* refers to the elongated, i.e. long and narrow, basidiospores.

MYCOBANK ACCESSION NUMBER—MB510019

Basidiocarp resupinate, thin, commonly just a faint bloom on wood, surface smooth (except for the anamorph); easily separable from substrate but not pellicular, byssoid to usually arachnoid, always porose, pure white or appearing greyish due to thinness. Margin not differentiated, mycelial cords absent.

Hyphal system monomitic, all septa with clamps, all hyphae thin-walled (except for the anamorph), KOH–, CB– but plasma light blue in CB, hymenium stained more strongly, hyphae slightly yellowish in IKI. Crystals not detected.

Subiculum very thin, composed of sparse horizontal hyphae. Subicular hyphae straight, (1.5–)2–3(–5) µm in diameter, sparingly branched and clamped, rarely inflated, with no ampullate septa.

Subhymenial hyphae richly branched, slightly wider than subicular hyphae, cylindrical to slightly irregular, (2–)2.5–4(–5) µm in diameter, often rather short-celled but nearly always clearly longer than wide, only rarely swollen.

Basidia clavate or more often cylindrical, sometimes slightly constricted, with four curved, slender sterigmata (2.8–4 µm long), (6–)8.2–12.5(–15)×(3.5–)4–5.5(–7) µm, L=10.5 µm, W=4.7 µm, n=70/7.

Basidiospores narrowly ellipsoid to phaseoliform, aculeate, commonly curved, ventral side straight to concave, sometimes with an elongated proximal end, slightly CB+ to CB–. Spines of variable length but mostly 0.3–0.7 µm, single spines ≤ 1 µm, but generally shorter in the largest spores. Spores (not including spines) (3.3–)3.7–5(–5.7)×(1.8–)2.1–2.8(–3.1) µm, L = 4.2 µm, W=2.4 µm, Q'=(1.27–)1.45–2.09(–2.5), Q=1.75, n=222/7. Spores (including spines) (3.8–)4.1–5.2(–5.5)×(2.6–)2.8–3.8(–4) µm, L=4.6 µm, W=3.3 µm, Q'=(1.13–)1.19–1.73(1.85), Q=1.42, n=78/6.

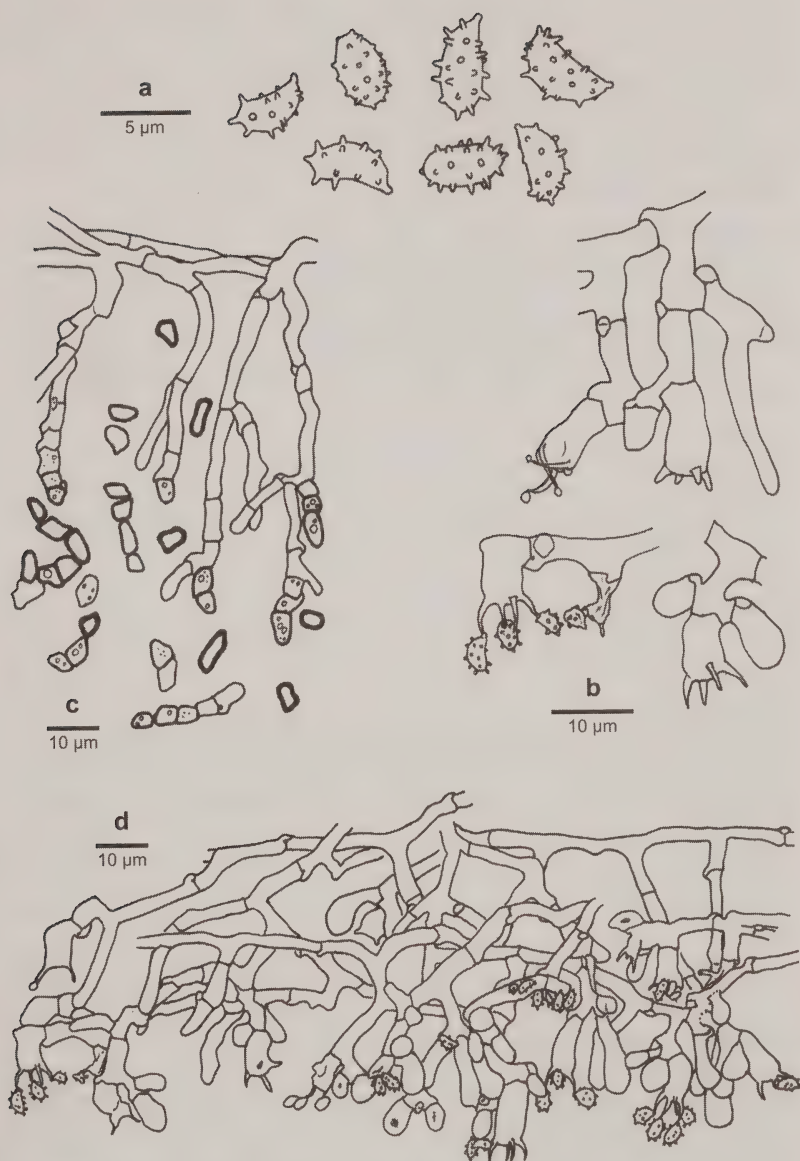


Fig. 1. *Trechispora elongata*, holotype. a) Basidiospores, b) basidia, c) conidiogenous hyphae and arthroconidia, d) section through the basidiocarp, slightly crushed.

Anamorph present or absent; forming white, roundish cushions, visible under the lens, and if large even with unaided eye. Conidia formed by fragmenting hyphae (arthroconidia), strongly CB+ and slightly dextrinoid, thick-walled, of variable length but of even thickness, with round corners, $(3.4-3.6-6.6(-6.8) \times (2.3-2.6-4.2(-4.7)) \mu\text{m}$, $L=5.1 \mu\text{m}$, $W=3.3 \mu\text{m}$, $n=60/2$, majority $3-3.5 \mu\text{m}$ wide. Anamorphic regions usually include some hymenium, but hymenium is formed mostly on different basal branches of subcicular hyphae than conidia. Hyphae beneath the conidia-forming layer occasionally swollen, up to $8 \mu\text{m}$ wide.

Distribution and ecology. All the specimens studied grew on strongly decomposed wood. The holotype grew on *Populus tremula*, the other six specimens on *Picea abies* or *Pinus sylvestris*. Six of the collections originate from the Nordic countries and one from Poland. Collections range from nemoral (mountains of southern Poland) to middle boreal vegetation zone (central Finland). Collecting sites vary in their quality. Mostly they seem to be average managed coniferous forests. Although inconspicuous and thus easily overlooked, the species seems to be rather rare.

Remarks. *Trechispora elongata* is characterised by smooth, porose hymenium, narrowly ellipsoid spores with a tapering proximal end, and by the presence of arthroconidia. No other species of *Trechispora* has such long, relatively narrow spores as *T. elongata*. It comes close to *T. farinacea* and allied species (see Larsson 1992). *Trechispora elongata* can be distinguished from all the other species of this group based on spore morphology even in the absence of the conidial stage (Fig. 2, Tab. 1).

The conidial stage of *T. elongata* is quite similar to that of *T. stevensonii* (Berk. & Broome) K.H. Larss.: both look macroscopically the same and their conidia are formed by fragmenting hyphae with clamps. There are slight differences: the conidiogenous hyphae of the new species are wider than those of *T. stevensonii* ($3-4 \mu\text{m}$ and $2.5-3 \mu\text{m}$, respectively), and the majority of conidia of *T. stevensonii* are under $3 \mu\text{m}$ wide ($3.2-5.4 \times 2.2-3.5 \mu\text{m}$, $n=110/4$) and weakly cyanophilous. Most conidia of *T. elongata* measure at least $3 \mu\text{m}$ wide and are rather strongly cyanophilous. Moreover, *T. stevensonii* has shorter, broadly ellipsoid basidiospores and a hydroid hymenium in contrast to the new species.

Specimens of *T. farinacea* s. str. with smooth hymenophores resemble *T. elongata*. *Trechispora farinacea* has subglobose to broadly ellipsoid spores and wide and short subhymenial cells; *T. elongata* has narrowly ellipsoid spores and slender subhymenial cells.

Trechispora caucasica (Parmasto) Liberta bears some similarities with *T. elongata*: smooth and fragile basidiocarp, a macroscopically similar conidial stage and slightly curved, ellipsoid basidiospores. However, *T. elongata* produces arthroconidia and *T. caucasica* blastoconidia. Of the two, *T. elongata* has in relation narrower spores with a clearly tapering proximal end not present in *T. caucasica*. There is a clear difference in the Q values of the spores (Tab. 1). In addition, aculei of spores of *T. caucasica* are longer than those of *T. elongata* (most close to $1 \mu\text{m}$), and it produces abundant rhizomorphs unlike *T. elongata*.

SPECIMENS STUDIED—*Trechispora elongata*. **Finland** (see *type). **Norway.** Sør-Trøndelag: Orkdal, Songli, on *Pinus*, 26.VIII.1982 K. H. Larsson *2907 (GB); on *Pinus*, 27.VIII.1982 K. H. Larsson 2935. Telemark: Porsgunn, on *Picea*, IX.1996 J. N. Stokland et al. 4651

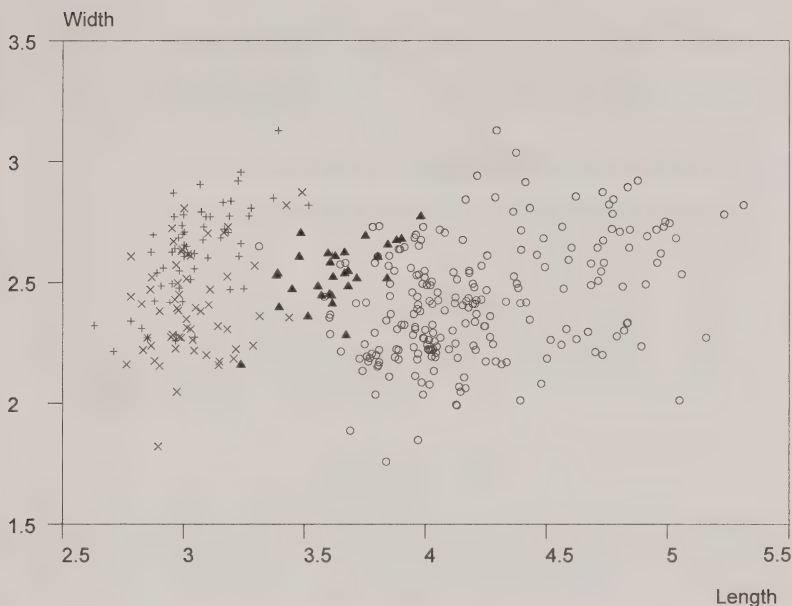


Fig. 2. Spore measurements (μm) comparing *Trechispora elongata* (○) with *T. caucasica* (▲), *T. farinacea* (+) and *T. stevensonii* (×). Each symbol represents a single spore. The points have been jittered, i.e. moved randomly within 0.05 μm around the original value along both axes.

Table 1. *Trechispora* species: basidiospore measurements of the specimens studied, spines excluded, and combined statistics for each species.

Specimen	Length (μm)	L	Width (μm)	W	Q'	Q	n
<i>T. caucasica</i>	(3.2–)3.4–3.9(–4.0)	3.63	(2.2–)2.3–2.7(–2.8)	2.53	1.3–1.6	1.43	30
<i>T. elongata</i>	(3.3–)3.7–5.0(–5.7)	4.22	(1.8–)2.1–2.8(–3.1)	2.41	1.3–2.5	1.75	222/7
holotype	(3.7–)3.8–5.0(–5.2)	4.34	(1.8–)2.0–2.7(–2.8)	2.29	1.5–2.5	1.89	38
Eriksson 1254	(3.7–)3.8–5.0	4.41	(2.0–)2.2–2.9(–3.0)	2.58	1.4–2.1	1.71	30
Hjortstam 11758	(3.6–)3.8–5.3(–5.7)	4.17	(2.1–)2.2–2.9(–3.1)	2.44	1.5–2.1	1.71	31
Larsson 2509	3.8–4.7(–5.1)	4.11	2.0–2.7(–2.9)	2.32	1.4–2.1	1.78	31
Larsson 2907	(3.7–)3.8–4.8(–5.2)	4.13	(2.0–)2.1–2.9(–3.1)	2.40	1.4–2.3	1.72	30
Larsson 2935	(3.3–)3.6–4.8(–5.0)	4.09	2.2–2.7(–2.8)	2.49	1.3–2.0	1.64	31
Stokland 4651	(3.7–)3.8–5.0	4.27	(1.9–)2.2–2.8	2.43	1.4–2.1	1.76	31
<i>T. farinacea</i>	(2.6–)2.8–3.4(–3.6)	3.06	(2.2–)2.3–2.9(–3.1)	2.63	1.0–1.4	1.17	60/2
Kotiranta 7336	(2.8–)2.9–3.5(–3.6)	3.06	2.3–2.8	2.59	1.1–1.4	1.18	30
Miettinen 6697	(2.6–)2.7–3.3(–3.4)	3.06	(2.2–)2.3–3.0(–3.1)	2.66	1.0–1.3	1.15	30
<i>T. stevensonii</i>	2.8–3.4(–3.5)	3.04	(1.8–)2.2–2.8(–2.9)	2.41	1.1–1.6	1.26	60/2
Jakobsson 1379	2.8–3.4(–3.5)	3.04	2.2–2.8(–2.9)	2.51	1.1–1.4	1.21	30
Saarenoksa 52190	2.8–3.3	3.04	(1.8–)2.0–2.6(–2.7)	2.30	1.1–1.6	1.32	30

(GB). **Poland.** Malopolska: Sucha Beskidzka, Babia Góra National Park, on *Picea*, 15.IX.1973 N. Hallenberg & K. H. Larsson 2509 (GB). **Sweden.** Dalsland: Dals-Ed, 3 km N of Ed, Kåringedalen, on *Pinus*, 2.IX.1980 K. Hjortstam 11758 (GB). Småland: Värnamo, in between Alandryd and Gislabo, on gymnosperm, 9.X.1955 J. Eriksson 1254 (GB).—Specimens with an anamorph are marked with an asterisk (*).

Trechispora caucasica. **Azerbaijan.** Leriki, on *Parrotia persica*, 14.XII.1962 E. Parmasto 16448 (holotype TAA).

Trechispora farinacea. **Finland.** Etelä-Häme: Lammi, biological station, on *Quercus*, IX.2002 O. Miettinen 6697 (H). Uusimaa: Inkoo, Sommaröarna, on gymnosperm, 26.V.1989 H. Kotiranta 7336 (H).

Trechispora stevensonii. **Finland.** Etelä-Häme: Lammi, biological station, on *Corylus avellana*, 13.IX.1997 S. Vanhanen 334b (H). Keski-Pohjanmaa: Raasik, Seminaariranta, on *Alnus*, 3.IX.1995 S. Jakobsson 1379 (H). Uusimaa: Helsinki, Viikki, on *Prunus padus*, 5.IX.1989 R. Saarenoksa 20689 (H); Helsinki, Vanhakaupunki, on *Prunus padus*, 18.VII.1990 R. Saarenoksa 52190 (H).—All specimens with an anamorph.

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Two new species of *Wrightoporia* (Basidiomycota, Aphyllophorales) from southern China

YU-CHENG DAI

yuchengd@yahoo.com

*Institute of Applied Ecology, Chinese Academy of Sciences
Shenyang 110016, China*

BAO-KAI CUI

baokaicui@yahoo.com.cn

*Institute of Applied Ecology, Chinese Academy of Sciences
Shenyang 110016, China*

*Graduate School, Chinese Academy of Sciences
Beijing 100039, China*

Abstract — Two new species of *Wrightoporia*, *W. casuarinicola* and *W. unguiformis*, are described from southern China, and illustrated descriptions of the two species are supplied. *W. casuarinicola* was collected on *Casuarina* from Guangxi Autonomous Region. It has a perennial growth, resupinate basidiocarps, a lilac to vinaceous brown pore surface, simple septate generative hyphae, dextrinoid and weakly cyanophilous skeletal hyphae, and broadly ellipsoid to subglobose, slightly thick-walled, ornamented and amyloid basidiospores. *W. unguiformis* was collected from Hainan Province. It has perennial, woody hard and unguulate basidiocarps with a distinct rusty brown to dark brown crust; the pore surface is buff to pale brown, and its tube mouths are thick. The skeletal hyphae are dextrinoid and strongly cyanophilous, and its basidiospores are thick-walled, echinulate and amyloid.

Key words — polypore, wood-rotting fungi, taxonomy

Introduction

The genus *Wrightoporia* was based on *Poria lenta* Overh. & J. Lowe which is a temperate species (Pouzar 1966), but most species in the genus have been recorded from subtropics and tropics (Buchanan & Ryvarden 2000, David & Rajchenberg 1985, 1987, Hattori 2003, Johansen & Ryvarden 1979, Lindblad & Ryvarden 1999, Loguercio-Leite et al. 1998, Rajchenberg 1983, Rajchenberg & David 1990, Ryvarden 1982, 1983, 1989, 2000, Ryvarden & Johansen 1980). Until now there are about 30 species transferred to or described in this genus, and five species have previously been reported from China (Cui & Dai 2006, Dai 1995, Dai et al. 2004).

During the study of diversity and ecology of wood-inhabiting fungi in China, two undescribed species were found from southern China. They have a dimitic hyphal system, dextrinoid and cyanophilous skeletal hyphae, and echinulate and distinctly amyloid basidiospores. These features fit the genus *Wrightoporia* very well, but no existing names are suitable for them and they are therefore described as new taxa.

Materials and methods

The studied specimens are deposited at the Herbarium of the Institute of Applied Ecology, Chinese Academy of Sciences (IFP) and the Mycological Herbarium of the Institute of Microbiology, Chinese Academy of Sciences (HMAS). The microscopic procedure follows Niemelä et al. (2004). Spores were measured from sections cut from the tubes. IKI = Melzer's reagent, IKI+ = amyloid, KOH = 5% potassium hydroxide, CB = Cotton Blue, CB+ = cyanophilous, CB- = acyanophilous. In presenting the variation in the size of the spores, 5% of measurements were excluded from each end of the range, and are given in parentheses. In the text the following abbreviations are used: L = mean spore length (arithmetic mean of all spores measured), W = mean spore width (arithmetic mean of all spores measured), Q = variation in the L/W ratios between the specimens studied (quotient of the mean spore length and the mean spore width of each specimen), n = number of spores measured from given number of specimens. Special colour terms are from Petersen (1996) and Rayner (1970).

Descriptions

Wrightoporia casuarinicola Y.C. Dai & B.K. Cui, sp. nov.

Fig. 1

Carpophorum perenne, resupinatum; facies pororum lilacina; pori rotundi vel angulati, 3–4 per mm. Systema hypharum dimiticum, hyphae generativae afibulatae, hyphae skeletales subiculi 2.8–9 µm in diam. Sporae perlate ellipsoideae vel subgloboseae, hyalinae, asperae, amyloideae, 3.5–3.9 × 2.7–3.2 µm.

Type. — China. Guangxi Autonomous Region, Beihai, on living tree of *Casuarina equisetifolia* L., 12.VIII.2005 Dai 6914 (holotype in IFP, isotype in H, HMAS).

Etymology. — *Casuarinicola* (Lat.): living on *Casuarina*.

Fruitbody. — Basidiocarps perennial, resupinate, when fresh corky to leathery, without odour or taste, becoming corky to woody corky upon drying, ca. 30 cm or more in longest dimension, 7 cm or more in widest dimension, tightly attached from the substrate. Sterile margin distinct, peach to brownish orange, up to 5 mm wide. Pore surface lilac when fresh, becoming vinaceous to cinnamon brown upon drying; pores round to angular, 3–4 per mm, tube mouths thin to thick, entire to lacerate. Context vinaceous to cinnamon brown, corky, up to 1 mm thick. Tubes vinaceous to vinaceous brown, corky, up to 6 mm long.

Hyphal structure. — Hyphal system dimitic; generative hyphae without clamp connections; skeletal hyphae dextrinoid, weakly CB+, tissue unchanged in KOH.

Context. — Generative hyphae infrequent, hyaline, slightly thick-walled, rarely branched, 2.4–4.8 µm in diam; skeletal hyphae dominant, hyaline to pale yellowish brown, thick-walled with a narrow lumen, frequently branched, more or less flexuous, interwoven, 2.8–9 µm in diam.

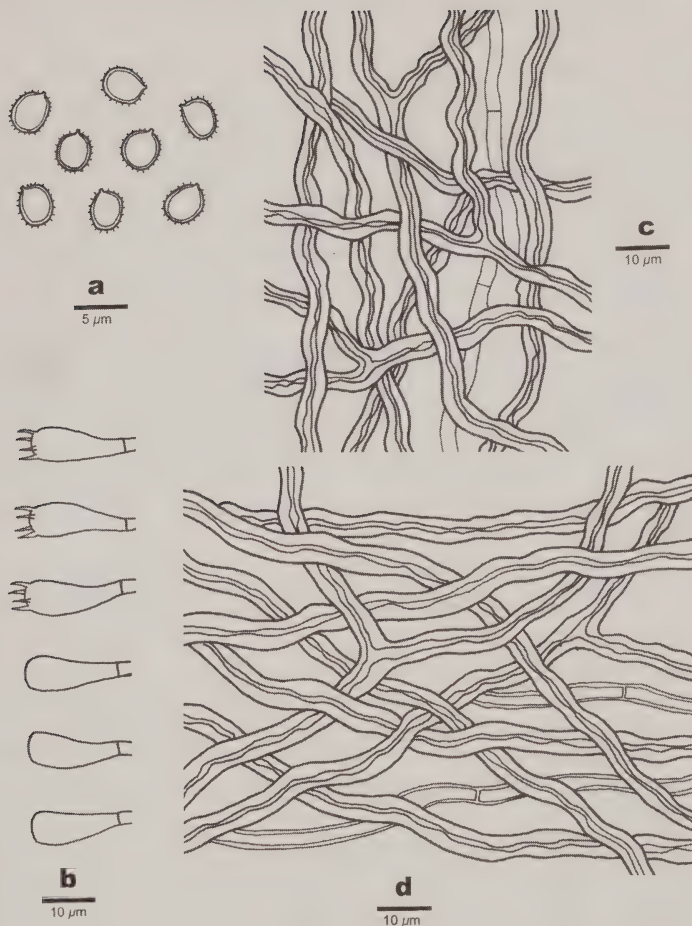


Fig. 1. Microscopic structures of *Wrightoporia casuarinicola* (drawn from the holotype). —a: Basidiospores. —b: Basidia and basidioles. —c: Hyphae from trama. —d: Hyphae from subiculum.

Tubes. — Generative hyphae infrequent, hyaline, thin-walled, rarely branched, 2–4 μm in diam; skeletal hyphae dominant, hyaline to pale yellowish brown, thick-walled with a narrow lumen, rarely branched, more or less flexuous, interwoven, 2–6.3 μm in diam. Cystidia and cystidioles absent; basidia clavate, with a basal simple septum and four sterigmata, 12–16.7 $\times$ 5–7.2 μm ; basidioles in shape similar to basidia, but slightly smaller.

Spores. — Basidiospores broadly ellipsoid to subglobose, hyaline, slightly thick-walled, echinulate, IKI+, CB–, $(3.3-3.5-3.9(-4) \times (2.6-2.7-3.2(-3.3) \mu\text{m}$, $L = 3.7 \mu\text{m}$, $W = 3 \mu\text{m}$, $Q = 1.2$ ($n = 30/1$).

Type of rot. — White rot.

Remarks. — *Wrightoporia casuarinicola* is characterized by its perennial growth habit, resupinate basidiocarps, lilac to vinaceous brown pore surface, simple septate generative hyphae, dextrinoid and weakly cyanophilous skeletal hyphae, and broadly ellipsoid to subglobose, slightly thick-walled, ornamented and amyloid basidiospores.

Among the species of *Wrightoporia*, six have simple septate generative hyphae: *W. bracei* (Murrill) I. Lindblad & Ryvarden, *W. efibulata* I. Lindblad & Ryvarden, *W. gillesii* A. David & Rajchenb., *W. perplexa* Ryvarden, *W. ramosa* A. David & Rajchenb. and *W. rubella* Y.C. Dai.

Wrightoporia casuarinicola is closely related to *W. bracei*, sharing resupinate, perennial basidiocarps, lilac pore surface, and broadly ellipsoid to subglobose basidiospores. Some specimens of the latter from South America were studied; it has smaller pores (5–7 per mm), and its context becomes black in KOH. Microscopically its basidiospores are thin-walled, its skeletal hyphae are distinctly cyanophilous in Cotton Blue, and some of its tramal skeletals are inflated up to $12 \mu\text{m}$ in diam. In addition, its generative hyphae are both simple septate and having clamp connections, a feature pointed out by Ryvarden (2000) as well.

Wrightoporia efibulata differs mainly from *W. casuarinicola* by having thin basidiocarps (less than 5 mm thick) with cream to buff pore surface, smaller pores (6–8 per mm), indextrinoid skeletal hyphae, and globose basidiospores ($3-3.5 \mu\text{m}$ in diam., Lindblad & Ryvarden 1999).

Wrightoporia gillesii differs from *W. casuarinicola* by having effused-reflexed basidiocarps with cream to ochraceous pore surface, smaller pores (8–9 per mm), narrow contextual skeletals (less than $5 \mu\text{m}$ in diam.) and smaller basidiospores ($3-3.5 \times 2-2.5 \mu\text{m}$, David & Rajchenberg 1987). In addition, based on our examination on a specimen from Uganda it has both simple septate and clamp connections on its generative hyphae.

Wrightoporia perplexa is distinguished from *W. casuarinicola* by its distinctly pileate fruitbody and inamyloid and larger basidiospores ($5-6 \times 4-5 \mu\text{m}$, Ryvarden 1989). *Wrightoporia ramosa* differs from *W. casuarinicola* by having bigger pores (2–3 per mm), gloeoplerous hyphae, and longer basidiospores ($4-4.5 \times 3-3.25 \mu\text{m}$, David & Rajchenberg 1987). *Wrightoporia rubella* is also found in China, but it has a strongly rhizomorphic fruitbody and larger basidiospores ($4-6 \times 3-4.2 \mu\text{m}$, Dai 1995).

Other specimens examined. — *Wrightoporia bracei*. **Argentina.** Misiones Prov., Iguazu National Park, Cataratas de Iguazu, on angiosperm wood, 1.III.1982 Ryvarden 19768 (H, dupl.). **Brazil.** Sao Paulo State, Sants, Ubatuba, Ilha Anchieta, on bamboo, 17.I.1987 Ryvarden 24237 (H, dupl.). **Costa Rica.** Guanacaste Prov., Santa Rosa National Park, on dead angiosperm wood, 27.X.1996 Lindblad 2253 (H, dupl.). **French Guiana.** Senter Rorota-Cayenne, 22.I.1947 Robert 1251 (H, dupl.). **Puerto Rico.** Guajataca Comm, Forest Verada, Nueva trail, on dead angiosperm wood, 26.VI.1996 Ryvarden 39094 (H, dupl.). — *W. efibulata*. **Costa Rica.** Alajuela, Bijagua, Albergue Helicones, 12.VII.2001 Ryvarden 43719 (H, dupl.). — *W. gillesii*. **Uganda.** Kanugu, Bwindi Forest National Park,

Kanungu sector, Parinari forest, on fallen rotting branches, 15.XI.2002 *Ipuleit* F1049 (H, dupl.); 29.V.2003 *Ipuleit* F1776 (H, dupl.).

***Wrightoporia unguliformis* Y.C. Dai & B.K. Cui, sp. nov.**

Fig.2

Carpophorum perenne, solitarium, unguatum; facies pororum bubalina vel pallide brunnea; pori rotundi, 1–3 per mm. Systema hypharum dimiticum, hyphae generativae fibulatae, hyphae skeletales contexti 2–5.4 µm in diam. Sporae perlate ellipsoideae vel subgloboseae, hyalinae, asperae, amyloideae, 4.3–5.1 × 3.8–4.3 µm.

Type. — China. Hainan Prov., Ledong County, Jianfengling Nature Reserve, on fallen angiosperm trunk, 4.I.1960 *Anonymous of Forestry Survey Team 37* (HMAS 29718, holotype in HMAS, isotype in IFP).

Etymology. — *Unguliformis* (Lat.), hoof-shaped, referring to the shape of basidiocarp.

Fruitbody. — Basidiocarps perennial, pileate, solitary, woody hard. Pileus unguate, projecting up to 12 cm, 9 cm wide, and 16 cm thick at base. Pileal surface rusty brown to reddish brown or umber brown, coarse, concentrically zonate and sulcate; margin blunt, greyish to pale brown. Pore surface buff to pale brown; pores round, 1–3 per mm, tube mouths thick, entire. Context buff, woody hard, ca. 0.5 cm thick; crust present at upper surface, rusty brown to dark brown, woody hard, up to 0.5 mm thick. Tubes multi-stratified, concolorous with pore surface, woody hard, up to 15 cm long; tube layers distinct, over 20 layers.

Hyphal structure. — Hyphal system dimitic; generative hyphae with clamp connections; skeletal hyphae dextrinoid, strongly CB+, tissue unchanged in KOH.

Context. — Generative hyphae infrequent, hyaline, slightly thick-walled, occasionally branched, 2–4.3 µm in diam.; skeletal hyphae dominant, hyaline to pale yellowish brown, thick-walled with a narrow lumen, frequently branched, interwoven, 2–5.4 µm in diam. Hyphae in crust pale yellowish, thick-walled with a narrow lumen, rarely branched, interwoven, 2–5.5 µm in diam.

Tubes. — Generative hyphae infrequent, hyaline, thin-walled, rarely branched, 1.4–3.2 µm in diam.; skeletal hyphae dominant, hyaline to pale yellowish, thick-walled with a narrow lumen, frequently branched, interwoven, 1.6–5 µm in diam. Cystidia absent, cystidioles present, fusoid, hyaline, thin-walled, 11.6–17 × 4.2–6 µm; basidia clavate, with a basal clamp connection and four sterigmata, 12.3–19 × 5–7.4 µm; basidioles in shape similar to basidia, but slightly smaller.

Spores. — Basidiospores broadly ellipsoid to subglobose, hyaline, thick-walled, with finely echinulate ornamentation, IKI+, weakly cyanophilous, (4.2–)4.3–5.1(–5.2) × (3.7–)3.8–4.3(–4.5) µm, L = 4.8 µm, W = 4.1 µm, Q = 1.2 (n = 30/1).

Type of rot. — White rot.

Remarks. — *Wrightoporia unguliformis* is characterized by its perennial, woody hard and unguate basidiocarp with a distinct rusty brown to dark brown crust, buff to pale brownish pore surface, thick tube mouths, dimitic hyphal system, dextrinoid and strongly cyanophilous skeletal hyphae, and thick-walled, echinulate and amyloid basidiospores. Macroscopically, *W. unguliformis* is very similar to *Fomitopsis pinicola*

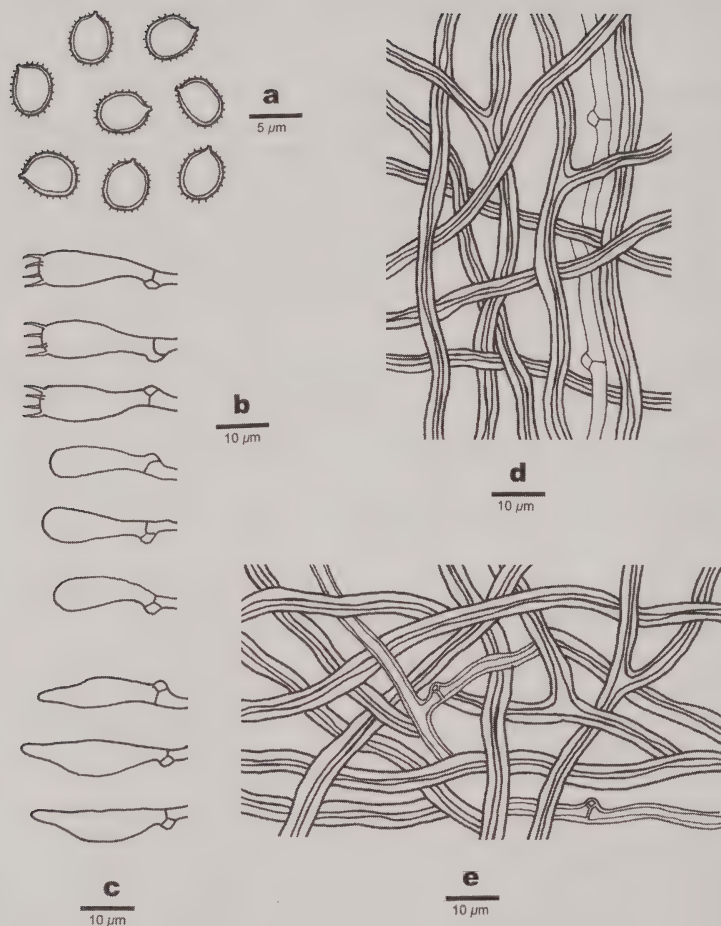


Fig. 2. Microscopic structures of *Wrightoporia unguiformis* (drawn from the holotype). —a: Basidiospores. —b: Basidia and basidioles. —c: Cystidioles. —d: Hyphae from trama. —e: Hyphae from context.

(Sw.:Fr.) P. Karst., however, the latter species has smooth and thin-walled basidiospores, its hyphae and basidiospores are IKI– and CB–, and it causes a brown rot.

Fourteen species of *Wrightoporia* have pileate basidiocarps, mainly recorded from tropical and subtropical areas (David & Rajchenberg 1985, 1987, Hattori 2003, Johansen & Ryvarden 1979, Loguercio-Leite et al. 1998, Núñez & Ryvarden 1999, Ryvarden 1982, 1989, 2000, Ryvarden & Johansen 1980). Most of them have an annual growth habit, but

W. dimidiata A. David & Rajchenb. is perennial with pileate basidiocarps. One specimen of *Wrightoporia dimidiata* from Singapore was examined; it differs from *W. unguliformis* by having dimidiate pileus, yellowish brown context, smaller pores (4–6 per mm), and its context becomes black in KOH. Microscopically its basidiospores are thin-walled and smaller ($3.5\text{--}4 \times 2.5\text{--}3 \mu\text{m}$). In addition, its hyphal structure is trimitic, binding hyphae are frequently present in both trama and context, and its skeletal and binding hyphae are acyanophilous or very weakly cyanophilous. Besides, as mentioned by David & Rajchenberg (1987) *W. dimidiata* has gloeoplerous hyphae and gloeocystidia.

Other specimen examined. — *Wrightoporia dimidiata*. Singapore. Bukit Timah Reserve, Rotten trunk of *Dipterocarpus*, 10.V.1994 Legoan (H, dupl.)

Although each of the above two new species is based on a single specimen, these two type specimens are huge, well-developed and in very good condition. We have studied the materials of all the related taxa, and the differences between our new species and related taxa are striking. For these reasons we venture to publish the descriptions of the two species.

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A new species of *Oxyporus* (Basidiomycota, Aphyllophorales) from Northwest China

BAO-KAI CUI

baokaicui@yahoo.com.cn

*Institute of Applied Ecology, Chinese Academy of Sciences
Shenyang 110016, China*

*Graduate School, Chinese Academy of Sciences
Beijing 100039, China*

MING-YUN HUANG

*Institute of Applied Ecology, Chinese Academy of Sciences
Shenyang 110016, China*

YU-CHENG DAI*

yuchengd@yahoo.com

*Institute of Applied Ecology, Chinese Academy of Sciences
Shenyang 110016, China*

Abstract—A new poroid *Aphyllophorales*, *Oxyporus subpopulinus*, is described from northwest China. It is characterized by perennial basidiocarps, abundant thick-walled and apically encrusted cystidia, ellipsoid and distinctly thin-walled basidiospores, and by growth on *Picea crassifolia* exclusively. The new species is very similar to *Oxyporus populinus*, but the latter species has subglobose and slightly thick-walled basidiospores, thin- to thick-walled cystidia, and it grows on angiosperm trees, especially on *Acer*.

Key words — polypore, wood-rotting fungi, taxonomy

Introduction

During a survey of the wood-inhabiting fungi in northwest China, six specimens of a polypore were collected on living trees of *Picea crassifolia*. The basidiocarps were perennial and had abundant thick-walled and apically encrusted cystidia and a monomitic hyphal structure with simple septate generative hyphae. The basidiospores are distinctly ellipsoid, hyaline and thin-walled. These characters indicate the genus *Oxyporus* (Bourdot & Galzin) Donk, but no suitable existing name is available for it and it is therefore described as new.

Materials and methods

The studied specimens are deposited at the Herbarium of the Institute of Applied Ecology, Chinese Academy of Sciences (IFP). Microscopy was studied, and measurements and drawings were made from slide preparations stained with Cotton Blue and Melzer's reagent. The microscopic routine used in the study is as presented by Dai & Niemelä (1997). Spores were measured from sections cut from the tubes. KOH stands for 5% potassium hydroxide, and CB is the abbreviation of Cotton Blue. CB+ means cyanophilous and CB- acyanophilous, and IKI- means both inamyloid and indextrinoid. In presenting the variation in the size of the spores, 5% of the measurements were excluded from each end of the range, and are given in parentheses. In the text the following abbreviations are used: L = mean spore length (arithmetical mean of all spores measured), W = mean spore width (arithmetical mean of all spores measured), Q = variation in the L/W ratios between the specimens studied (quotient of the mean spore length and the mean spore width of each specimen), n = number of spores measured from given number of specimens. Special colour terms are from Petersen (1996) and Anonymous (1969).

Description

Oxyporus subpopulinus B.K. Cui & Y.C. Dai, sp. nov.

Fig. 1

Carpophorum perenne, pileatum, solitarium vel imbricatum. Facies pororum crenea vel pallide bubalina; pori rotundi vel angulati, 5–7 per mm. Systema hypharum monomiticum, hyphae afibulatae, hyphae contexti 3–4.6 µm in diam. Sporae hyalinae, ellipsoideae, 3.4–4.7 × 2.3–3.2 µm.

Type. — China. Qinghai Prov., Xunhua County, Mengda Nature Reserve, on living tree of *Picea crassifolia*, 30.VIII.2005 Cui 2313 (holotype in IFP, isotype in HMAS & H).

Etymology. — *Subpopulinus* (Lat.): resembling *Oxyporus populinus*.

Fruitbody. — Basidiocarps perennial, pileate or rarely effused-reflexed, mostly imbricate, occasionally solitary, woody hard when dry, without odour or taste when fresh. Pileus broadly attached, elongated, projecting up to 4 cm long, 13 cm wide, and 5 cm thick at the base. Pileal surface white to cream, or pale buff, azonate, margin sharp. Pore surface cream to pale buff; pores round to angular, 5–7 per mm, dissepiments thin, entire. Context white to cream, corky, azonate, up to 6 mm thick. Tubes concolorous with pore surface, cream to pale buff, corky, each layer up to 1–2 mm long, tube layers distinct.

Hyphal structure. — Hyphal system monomitic; hyphae simple septate, IKI-, more or less CB+, unchanged in KOH.

Context. — Contextual hyphae hyaline, thick-walled, frequently simple septate, occasionally branched, interwoven, 3–4.6 µm in diam.

Tubes. — Tramal hyphae hyaline, mostly thick-walled, some thin-walled, rarely branched, frequently simple septate, straight, parallel along the tubes, 2.2–3.5 µm in diam. Hyphoid cystidia abundant, clavate, distinctly penetrating above the hymenial surface, deeply rooting in the trama, thick-walled, apically encrusted with coarse crystals, 17–28 × 3.4–5.2 µm; basidia broadly clavate to barrel-shaped, with four sterigmata and a basal simple septum, 7.6–12 × 5–6 µm; basidioles in shape similar to basidia, but slightly smaller.

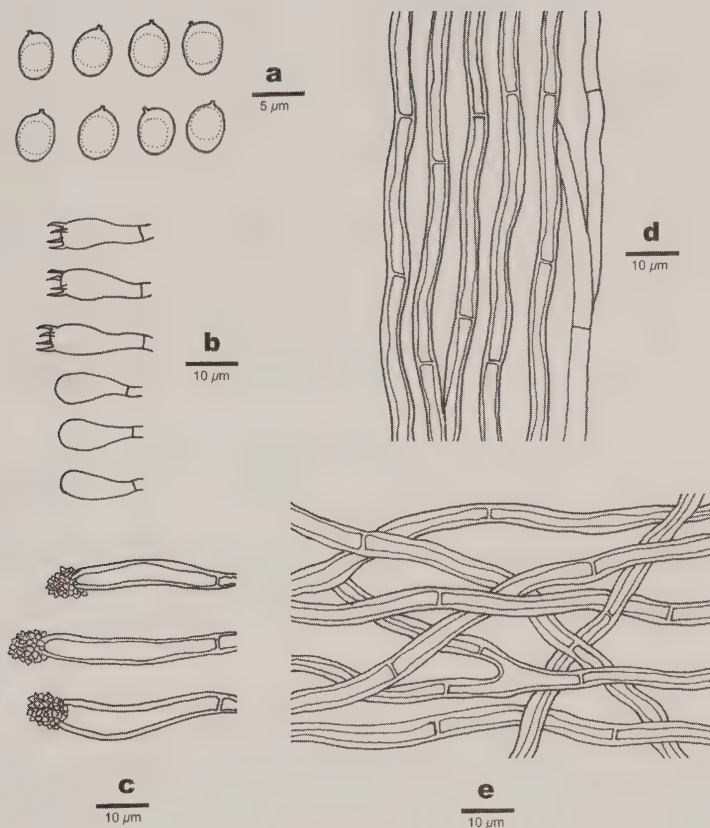


Fig. 1. Microscopic structures of *Oxyporus subpopulinus* (drawn from the holotype). —a: Basidiospores. —b: Basidia and basidioles. —c: Cystidia. —d: Hyphae from trama. —e: Hyphae from context.

Spores. — Basidiospores ellipsoid, hyaline, thin-walled, smooth, usually bearing a big guttule, IKI–, CB–, (3–)3.4–4.7(–5) × (2.1–)2.3–3.2(–3.5) µm, L = 3.9 µm, W = 2.9 µm, Q = 1.3–1.4 (n=180/6).

Additional specimens (paratypes) examined. — **China.** Gansu Prov., Yuzhong County, Xinglongshan Nature Reserve, on base of living *Picea crassifolia*, 27.VIII.2005 Cui 2236 (IFP) & 2238 (IFP); on living tree of *Picea crassifolia*, 27.VIII.2005 Cui 2240 (IFP); Qinghai Prov., Xunhua County, Mengda Nature Reserve, on living tree of *Picea crassifolia*, 29.VIII.2005 Cui 2251 (IFP) & 2261 (IFP).

Type of rot. — White rot.

Remarks. — *Oxyporus subpopulinus* is characterized by perennial basidiocarps, abundant thick-walled and apically encrusted cystidia, distinctly ellipsoid and thin-walled basidiospores, and by growth on *Picea crassifolia* exclusively. Macroscopically *Oxyporus subpopulinus* is very similar to *O. populinus* (Schumacher:Fr.) Donk, but the latter has distinctly subglobose and slightly thick-walled basidiospores, thin- to thick-walled cystidia, and mostly thin-walled tramal hyphae and it grows on angiosperm trees, especially on *Acer* (Dai 1998, Gilbertson & Ryvarden 1987, Núñez & Ryvarden 2001, Ryvarden & Gilbertson 1994).

Oxyporus nobilissimus W.B. Cooke has perennial basidiocarps, abundant thick-walled, hyphoid cystidia, and occurs on coniferous trees. However, it has both larger pores and basidiospores (3–5 per mm, 5.5–7 × 4–5 µm, Gilbertson & Ryvarden 1987).

According to our field investigations, *Oxyporus subpopulinus* only occurs on living trees of *Picea crassifolia*, and some trees were killed by the fungus. Therefore, this polypore seems to be pathogenic on the spruce, but further study is needed to confirm its pathogenicity.

Other specimens examined. — *Oxyporus populinus*. **China.** Beijing, Baihuashan, on living tree of *Acer*, 2.XI.1993 Dai 1824 (IFP, H); 2.XI.1993 Dai 1839 (IFP, H); Jilin Prov., Antu county, Changbaishan Nature Reserve, on living tree of *Acer*, 16.IX.1995 Dai 2149 (IFP, H); 13.VIII.1997 Dai 2415 (IFP, H); 19.IX.1998 Dai 3015 (IFP, H); on dead tree of *Populus*, 13.IX.1995 Dai 2084 (IFP, H); Fushong County, Shuguang, on living tree of *Acer*, 22.VII.1993 Dai 671 (IFP, H); Huinan County, Hongqi, on dead tree of *Acer*, 13.X.1993 Dai 1608 (IFP, H). **Finland.** Uusimaa, Helsinki, Arabia, on fallen trunk of *Acer*, 2.XI.1996 Dai 2311 (H); on stump of *Acer*, 2.XII.1996 Dai 2354 (H).

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**Northern *Antrodiella* species:
the identity of *A. semisupina*,
and type studies of related taxa**

OTTO MIETTINEN¹*, TUOMO NIEMELÄ¹ & WJACHESLAV SPIRIN²

*otto.miettinen@helsinki.fi

¹ Finnish Museum of Natural History, Botanical Museum
P.O.Box 7, FI-00014 University of Helsinki, Finland

² Kirochnaya 8–12,
191028 St.-Petersburg, Russia

Abstract—Type collections of *Antrodiella* (Basidiomycota, polypores) from Europe, North America and Siberia were studied. The current concept of *Antrodiella semisupina* includes many species; the European taxon is *A. pallescens*, comb. nov., while *A. semisupina* sensu typi occurs in North America. The identity of *A. romellii* was clarified and an epitype was selected to supplement its poor-quality holotype. *A. serpula*, comb. nov. is an earlier name for *A. hoehnellii*. In addition, the following new combinations are made: *A. leucoxantha* (= *A. genistae*), *A. subradula* (type from Siberia), *A. pachycheiles* (type from eastern U.S.A.), and *A. ellipsospora* (type from Siberia). *A. beschidica* and *A. farinacea* are reduced to the synonymy of *A. pallescens*; *A. thompsonii* is accepted as a good species. *Antrodiella ichnusana*, described from the Mediterranean, is reported from North Europe. Several other *Antrodiella* species are discussed. Spores are illustrated and their dimensions are given for the 17 accepted species. Gloeocystidia are considered an unreliable character for delimiting species in *Antrodiella*.

Key words—taxonomy, nomenclature, polyporoid clade

Introduction

The genus *Antrodiella* was described by Ryvarden & Johansen (1980) for *Polyporus semisupinus* and a few related East African species. The number of species grew rapidly, and at present 58 names are included in *Antrodiella* (Index Fungorum 2006). The genus has now become widely accepted. Vampola & Pouzar (1996), Ryvarden (2003) and Dai (2004) have published summarising articles on the genus. Johannesson et al. (2000) showed with ca. ten European species that they form a monophyletic group.

While studying specimens of *Antrodiella* it soon became evident that there are misconceptions and older names that cause changes in the current nomenclature. All the Nordic species are included, but when searching for correct species names, many North American and Siberian taxa were also reviewed.

Materials and methods

The work is mostly based on type and other herbarium materials, but North and Central European species have been studied extensively in the field, too. Collections in the herbarium H (Helsinki) served for the basis of the study, and the listed specimens are preserved in H unless otherwise indicated. Type materials and reference specimens were obtained from the herbaria BPI, HMAS, HUBO, K, KUO, L, NY, NYS, OULU, PAC, PC, PRM, and S.

The basic mountant medium used was Cotton Blue (abbreviated CB): 0.1 mg aniline blue (Merck 1275) dissolved in 60 g pure lactic acid. CB+ means cyanophily, CB(+) weak but distinct cyanophilous reaction, CB- acyanophily. Amyloid vs. dextrinoid reaction was studied in Melzer's reagent (IKI): 1.5 g KI, 0.5 g I, 22 g chloral hydrate, aq. dest. 20 ml; IKI- means neither amyloid nor dextrinoid reaction. Also 5% KOH was used for mountant; KOH- meaning almost unchanged. Spore and other measurements were made and illustrations were drawn in CB. As a rule 30 spores were measured from each specimen selected for closer scrutiny. Measurements were done using $\times 1000$ or $\times 1250$ magnification, phase contrast illumination and oil immersion; eyepiece scale bar with 1- μm -grid was used, and dimensions were estimated subjectively with an accuracy of 0.1 μm .

Following symbols are used for spore measurements: L=mean length, W=mean width, $Q=L/W$, i.e. average length divided by average width, Q' =length/width ratio of individual spores, n=number of spores measured from given number of specimens, for instance 90/3 means 90 spores measured from 3 specimens. In presenting the variation of spore size and Q' , the whole range is given in parentheses; the 90% range excluding the extreme 5% of values from both ends is given without parentheses; in case these values are identical, parentheses are omitted. MycoBank (<http://www.Mycobank.org>) accession numbers for the new combinations are given in parentheses after the species title in question.

The genus *Antrodiella*

Antrodiella sensu stricto is microscopically well defined and easily recognizable. However, some species now addressed to *Antrodiella* may fit better in other genera, e.g. *A. fissiliformis* and *A. ussuri*. Together with *Junghuhnia*, *Steccherinum*, *Flaviporus*, and perhaps *Irpex* and *Flavodon*, *Antrodiella* makes a complex, whose phylogenetic relationships are still unclear. In an analysis by Binder et al. (2005) *Antrodiella*, *Junghuhnia*, *Steccherinum* and *Ceriporiopsis* belong to the same lineage within the polyporoid clade.

Typical species of *Antrodiella* have annual, leathery tough basidiocarps with a tendency to effused growth, although thin, fingernail-shaped or spatulate pilei develop commonly. Context is thin and almost white, and overall colour is white to cream, with hues of tan, grey, orange and yellow. These are white-rot fungi, and strikingly many are successor species (Niemelä et al. 1995), which appear on trees previously decayed by certain other fungi. Such ecological links offer good hints for identification.

Species are often difficult to separate because of the small size of the basidiocarps and their fairly uniform microscopy. Hyphal structure and pore size can provide useful

information, but spore dimensions are the key character. Spores of *Antrodiella* are small, subglobose, ellipsoid or short cylindrical. Hyphal system is dimitic, generative hyphae mostly with clamp connections, and skeletal hyphae narrow but thick-walled with a capillary lumen. The skeletal of context/subiculum may have occasional branches, and then the structure approaches trimitic. Typical to the genus is that skeletal walls are slightly cyanophilous, unlike in *Antrodia*, but in a similar way as in *Junghuhnia* and *Steccherinum*. In some species they are weakly amyloid or dextrinoid. Hymenial cells are small, basidia with 4 sterigmata, usually short clavate, basidioles similar but shorter, and cystidioles poorly differentiated, similar to basidioles but with a tapering apex. Gloeocystidia have been reported from several species, but they tend to be inconspicuous. We will discuss that feature later on.

The very small spore size, about $3\text{--}4 \times 2 \mu\text{m}$, makes their measuring troublesome, and satisfactory results can only be achieved with phase contrast microscope, oil immersion, $\times 1000$ or $\times 1250$ magnification, and viscid mountant in which the spores stay still—we are using Cotton Blue in lactic acid. Melzer's reagent and even more KOH let freely floating spores vibrate and roll continuously, and no exact dimensions can be measured. It is theoretically impossible to reach the resolution of $0.1 \mu\text{m}$ using visible light, but such distances can be subjectively estimated with a $1\text{-}\mu\text{m}$ -grid eyepiece. Measuring 30 spores from each specimen results in a tolerably small error when comparing average spore sizes between specimens and species (Parmasto & Parmasto 1987). In objects of this size, the eye easily catches different shapes, and, indeed, our measurement values agree with visible differences. Small systematic deviations may exist between individual observers, and so the measurements made by a single person are the most comparable.

Type species of the genus

Antrodiella semisupina (Berk. & M.A. Curtis) Ryvarden

in Ryvarden & Johansen, Prelim. Polypore Fl. East Africa: 261, 1980. *Polyporus semisupinus* Berk. & M.A. Curtis, in Berkeley, Grevillea 1:50, 1872. Holotype: 'Herb. Berk. 1879. Grev. 1:50. 1872. 5860 Pol. (*Anoderm.*) *semisupinus* [faint: N.S.]. Nov. Angl. Sprague' (K, studied).

Basidiocarps effused-reflexed with ca. 1×2 cm resupinate parts, and fingernail-shaped caps, projecting 4–6 mm, 1 mm thick at base, broadly attached and downcurved, margin sharp, when dry hard. Overall colour brownish cream with some mouse grey on upper side close to the attachment, and brown, translucent patches at bruised edges; however, colours have certainly changed in the old specimen. Pores round to angular (5–)6–8(–9) per mm, orifices regular or minutely denticulate; tubes in older (central) parts merged together, split, and pores then larger than given above. Hyphal system dimitic; generative hyphae clamped and thin-walled, skeletal hyphae dominating in all parts, flexuous, translucent, fairly thick, $(2\text{--})3\text{--}4.2\text{--}(5) \mu\text{m}$ diam., thick-walled, CB–, IKI– and KOH–, in tube trama subparallel and glued together. No cystidia, no gloeocystidia; angular crystal clusters abound among the hyphae. Hymenial cells ca. $11\text{--}13.3 \times 3.2\text{--}4.7 \mu\text{m}$, basidia with 4 sterigmata. Spores $(2.6\text{--})2.7\text{--}3.3\text{--}(3.4) \times (1.7\text{--})1.8\text{--}2.3\text{--}(2.5) \mu\text{m}$, thin-walled, CB–, IKI–, almost egg-shaped, ventral side clearly rounded, not straight and never concave; no guttulae.

SPECIMENS EXAMINED—U.S.A. (see type).

The name *Antrodiella semisupina* has traditionally been addressed in Europe to the pileate or effused-reflexed species, typically growing on and around dead basidiocarps of *Fomes fomentarius* (L. : Fr.) J. Kickx f. However, after studying the type of *Polyporus semisupinus*, a different picture unfolded.

The collection includes two pieces of wood glued on a small sheet of paper, one piece broken and its fungus lost, the other bearing two small basidiocarps, which arise directly from wood. The host is most probably *Quercus* (of the *Q. rubra* group, teste Tuuli Timonen & Pirkko Harju, H) and the wood is white-rotted, with no mention or remnants of any preceding fungus. Even though small and over 100 years old, the specimen is in a fairly good condition, fertile, and most of the essential characteristics can be observed.

Pores size of the type specimen of *P. semisupinus* and the European specimens so called are fairly similar. A clear difference is seen in spores: they are shorter and slightly thicker in the type than in the European '*A. semisupina*'. The difference (Fig. 1) can be seen from the shape even without measuring. The lack of cyanophily in the skeletal of the holotype is deviating within the genus: *Antrodiella* species typically have a slight but clear CB+ reaction in their skeletal hyphae, which links them with the genera *Steccherinum* and *Junghuhnia*; cyanophily of the skeletal is distinct in the European '*A. semisupina*'. Anyhow, general habit and the other microscopic characters of the holotype are so similar to the other species in the group that we have no basis to propose a separation of *A. semisupina* sensu typi from the rest.

The identity of *P. semisupinus* sensu typi should be solved from further collections and field notes in eastern North America (New England), the area where the species was described. For instance, host characteristics and possible links with preceding other fungi would be of interest. The detailed description of *P. semisupinus* by Overholts (1953) matches very well with the type (for instance spores ' $2.5\text{--}3\times 2\text{--}2.5\text{ }\mu$ ', no mention of link with *Fomes fomentarius*) but not with the species so named in Europe.

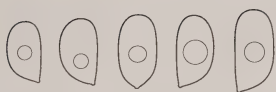
All this means that the epithet *semisupina* is inapplicable for the taxon growing almost invariably on wood decayed by *Fomes fomentarius* and usually arising from its dead basidiocarps. Of the species known to us, *A. semisupina* sensu typi comes closest to *A. faginea*.

Notes on *Antrodiella* species

Antrodiella americana Ryvarden & Gilb.

Mycotaxon 19:138, 1984. *Poria aestivalis* Overh., Bull. Penn. Agric. Exp. Sta. 418:20, 1942 (nom. inval.: ICBN (St Louis) Art. 36.1). Holotype: *Poria aestivalis* [sic] Overholts, U.S.A., Pennsylvania, Cook Forest, *Fagus grandifolia*, 23.VI.1932 Overholts & White 14364 (PAC 0237862, studied).

Annual, resupinate, soft-looking but difficult to tear apart, when dry cardboard-like, basidiocarps irregularly roundish. Sterile margin fibrous, white. Pores (1–)2–4(–5) per mm, cream-coloured or honey yellow; orifices lacerate. Section: subiculum cream-coloured, tubes honey-coloured or resinous-looking. Dimitic, generative hyphae with clamps, skeletal CB(+), IKI–, KOH–, in subiculum interwoven, (2.1–)2.2–3.1(–3.5)



Antrodiella americana (Niemelä 3222)



Antrodiella canadensis (Niemelä 8103)



Antrodiella citrinella (type)



Antrodiella ellipsospora (type)



Antrodiella faginea (type)



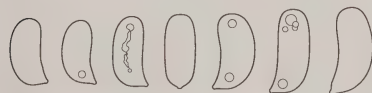
Antrodiella genistae (type)



Antrodiella ichnusana (Saarenoksa 6992)



Antrodiella leucoxantha (type)



Antrodiella onychoides (type)



Antrodiella pachycheiles (type)



Antrodiella pallasii (type)



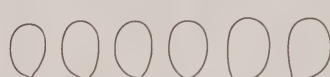
Antrodiella pallescens (type)



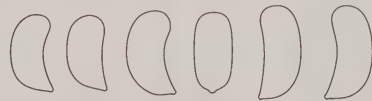
Antrodiella parasitica (Vampola 1899)



Antrodiella romellii (epitype)



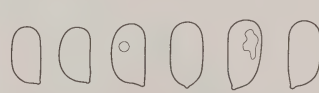
Antrodiella semisupina (type)



Antrodiella serpula (type)



Antrodiella subradula (type)



Antrodiella thompsonii (type)



Figure 1. Spores of *Antrodiella* species.

Table 1. Spore measurements of *Antrodiella* species treated in this paper.

Asterisk (*) marks specimens with gloeocystidia. Currency sign (¤) marks specimens whose ITS has been sequenced by Johannesson et al. (2000). Column *n* gives the number of spores / specimens measured, if applicable. Summarising data of *A. pallescens* exclude *A. beschidica* and *A. farinacea*.

Species / specimen	n	L variation	L	W variation	W	Q' variation	Q
semisupina	70/1	(2.6-)2.7-3.3(-3.4)	3.00	(1.7-)1.8-2.4(-2.5)	2.09	1.3-1.6	1.44
americana	130/4	(3.1-)3.2-4.4(-4.7)	3.72	(1.7-)1.9-2.3	2.05	(1.5-)1.6-2.1	1.81
holotype	30	3.1-3.9	3.42	1.9-2.2(-2.3)	2.03	1.5-2.0(-2.1)	1.69
Niemelä 17.X.1976	40	(3.2-)3.3-.4.3(-4.4)	3.72	(1.7-)1.8-2.3	2.02	(1.6-)1.7-2.1	1.84
Niemelä 3332	30	3.2-4.0(-4.2)	3.53	(1.8-)1.9-2.2(-2.3)	2.06	(1.5-)1.6-1.9	1.72
Niemelä 6656	30	(3.8-)3.9-4.7	4.20	1.9-2.3	2.11	1.8-2.1	1.72
canadensis	100/3	(3.0-)3.1-3.9(-4.0)	3.43	(2.2-)2.4-3.0(-3.1)	2.64	(1.1-)1.2-1.4	1.30
Anttila 18.VIII.1993	30	3.1-3.8(-3.9)	3.43	2.4-3.0(-3.1)	2.69	(1.1-)1.2-1.3	1.27
Niemelä 8103	40	(3.0-)3.1-3.7	3.34	(2.2-)2.4-2.9	2.58	1.2-1.4	1.30
Penttilä 1321¤	30	3.3-4.0	3.57	(2.3-)2.4-3.0	2.66	1.3-1.4	1.34
citrinella	160/4	(2.8-)2.9-3.4(-3.7)	3.14	(2.0-)2.1-2.6(-2.8)	2.31	(1.1-)1.3-1.5	1.36
isotype	60	3.0-3.5(-3.7)	3.21	(2.0-)2.2-2.7(-2.8)	2.36	(1.1-)1.2-1.5	1.36
Laurila & Renvall 1982	30	2.8-3.3	3.05	2.1-2.5	2.26	1.2-1.5	1.35
Niemelä 6640	40	(2.8-)2.9-3.3(-3.5)	3.07	(2.0-)2.1-2.5(-2.6)	2.28	(1.2-)1.3-1.5	1.35
Penttilä 1223	30	3.0-3.4	3.15	(2.1-)2.2-2.5(-2.6)	2.30	1.3-1.4(-1.5)	1.37
ellipsospora	70	3.2-4.0(-4.1)	3.51	(1.7-)1.8-2.1(-2.3)	1.95	(1.6-)1.7-2.0(-2.1)	1.80
faginea	646/37	(2.5-)2.8-3.7(-4.5)	3.20	(1.6-)1.8-2.2(-2.4)	1.97	(1.4-)1.5-1.8(-2.3)	1.62
holotype*¤	60	(2.9-)3.0-3.9(-4.3)	3.26	1.8-2.1	1.96	1.5-1.9(-2.0)	1.66
Dai 1077	30	(2.9-)3.0-3.7(-3.9)	3.29	(1.9-)2.0-2.3	2.09	1.5-1.7	1.58
Erkkilä 535	30	(2.8-)2.9-3.7(-3.9)	3.18	1.8-2.1	1.96	1.5-1.8	1.62
Kulju 7001*	32	(2.8-)2.9-3.7	3.16	1.7-2.0	1.85	(1.5-)1.6-1.9(-2.2)	1.71
Savola 18.IX.2003	30	2.9-3.6(3.9)	3.22	1.8-2.2(-2.3)	2.03	1.5-1.7(-1.8)	1.59
Niemelä 6867	30	2.9-3.4(-3.5)	3.13	1.8-2.2	1.99	(1.4-)1.5-1.7(-1.7)	1.57
Renvall 3217*¤	30	(2.9-)3.0-3.6	3.24	(1.7-)1.8-2.2	1.97	1.5-1.9	1.64
Renvall 3347*¤	30	2.9-3.4(-3.6)	3.15	(1.7-)1.8-2.1(-2.2)	1.90	1.5-1.8	1.66
Romell 24.VIII.1910*	30	3.0-3.5(-3.6)	3.23	1.9-2.3	2.08	1.5-1.7	1.56
Saarenoksa 18786	30	2.8-3.7(-3.8)	3.16	(1.7-)1.8-2.2	1.96	(1.4-)1.5-1.8	1.61
Saarenoksa 21687*	30	(3.0-)3.2-3.9(-4.0)	3.46	1.9-2.3(-2.4)	2.11	1.5-1.8(-1.9)	1.64
ichnusana	150/5	(3.9-)4.0-5.2(-5.4)	4.55	(1.7-)1.8-2.1(-2.2)	1.95	(2.0-)2.2-2.6(-2.8)	2.33
Bernicchia 7694	30	(4.1-)4.3-5.2(-5.3)	4.74	(1.8-)1.9-2.2	2.02	(2.0-)2.1-2.6	2.35
Saarenoksa 6992	30	4.0-5.3(-5.4)	4.64	1.7-2.2	1.93	2.2-2.7(-2.8)	2.40
Saarenoksa 11090	30	3.9-5.1	4.37	(1.7-)1.8-2.0	1.88	2.1-2.6	2.32
Saarenoksa 13892	30	(3.9-)4.0-5.2(-5.4)	4.45	1.8-2.1(-2.2)	1.94	2.1-2.5	2.29
Saarenoksa 16390	30	(4.0-)4.1-4.9(-5.1)	4.54	1.8-2.1(-2.2)	1.98	(2.0-)2.1-2.6	2.29
leucoxantha	412/9	(2.9-)3.2-4.5(-5.6)	3.89	1.5-1.9(-2.1)	1.71	(1.7-)1.9-2.7(-2.9)	2.23
lectotype*	62	(3.2-)3.4-4.7(-5.6)	3.89	(1.5-)1.6-2.0	1.79	(1.8-)1.9-2.5(-2.9)	2.17
lectotype of genistae	70	(2.9-)3.0-4.1(-4.3)	3.53	1.5-1.9(-2.0)	1.71	(1.7-)1.8-2.3(-2.4)	2.07
Jakobsson 918*	30	3.7-4.8(-5.3)	4.12	1.5-1.8(-2.1)	1.65	(2.1-)2.2-2.8	2.47
PRM 854493	30	(3.1-)3.2-3.8	3.47	1.5-1.8(-1.9)	1.65	(1.8-)1.9-2.4	2.10
PRM 871821	30	3.4-4.5(-5.0)	3.96	1.5-1.9	1.71	2.1-2.5(-2.6)	2.31
PRM 889755*	40	3.4-4.2(-4.3)	3.85	(1.6-)1.7-1.9(-2.0)	1.80	(1.9-)2.0-2.4	2.14
PRM 890852	30	3.2-3.9(-4.0)	3.46	(1.5-)1.6-1.9	1.75	1.8-2.3	1.98
Saarenoksa 58589	60	(3.3-)3.5-4.4(-4.5)	3.85	(1.5-)1.6-1.8(-1.9)	1.68	(2.1-)2.2-2.5(-2.6)	2.29
Särkkä 50	60	(3.5-)3.7-4.7	4.14	1.5-1.8(-1.9)	1.66	(2.1-)2.2-2.9	2.50
onychoides	180/5	(3.3-)3.2-4.8(-5.3)	3.86	(1.5-)1.6-1.9(-2.4)	1.75	(1.6-)1.8-2.7(-3.0)	2.21
holotype	60	(3.7-)3.8-4.9(-5.1)	4.31	1.6-1.9(-2.0)	1.77	(2.1-)2.2-2.7	2.44
Niemelä 3227	30	3.0-4.0(-4.3)	3.39	(1.5-)1.6-1.8	1.70	1.7-2.3(-2.4)	1.99
Saarenoksa 24791	30	(3.0-)3.1-4.3(-5.3)	3.64	(1.6-)1.7-1.9	1.78	(1.7-)1.8-2.2	1.99
Saarenoksa 45791	30	(3.1-)3.2-4.9(-5.3)	3.89	(1.5-)1.6-2.1(-2.4)	1.81	(1.6-)2.0-2.4	2.15

Table 1 continued.

Species / specimen	n	L variation	L	W variation	W	Q' variation	Q
Salonen 26.IX.2000	30	(3.2-)3.3-4.5	3.72	1.5-1.9(-2.0)	1.67	2-2.5(-3.0)	2.23
pachycheiles	120/1	(3.1-)3.3-4.2(-4.4)	3.67	(2.0-)2.2-2.8(-3.1)	2.45	(1.3-)1.4-1.7	1.50
pallasii	190/6	(2.9-)3.0-3.7(-3.9)	3.23	(1.6-)1.8-2.1(-2.3)	1.93	(1.4-)1.5-1.9	1.67
isotype ^π	30	(2.9-)3.0-3.8	3.34	1.8-2.2	1.98	1.5-1.9	1.69
Kujala & Eriksson 9416	30	2.9-3.7(-3.8)	3.29	1.8-2.1(-2.2)	1.99	1.5-1.8	1.65
Niemelä 2143	30	2.9-3.3(-3.4)	3.12	(1.6-)1.7-2.0	1.85	1.5-1.9	1.69
Niemelä 6580	40	(2.9-)3.0-3.7(-3.8)	3.21	1.8-2.1(-2.2)	1.93	(1.4-)1.5-1.9	1.66
Niemelä 6617	30	(2.9-)3.9-3.5(-3.6)	3.21	1.7-2.0	1.90	1.5-1.8(-1.9)	1.68
Niemelä 7139	30	(2.9-)3.0-3.7(-3.9)	3.24	(1.7-)1.8-2.3	1.94	1.5-1.8	1.67
pallescens	361/11	(2.9-)3.0-4.1(-4.8)	3.47	(1.6-)1.7-2.0(-2.3)	1.84	(1.5-)1.7-2.2(-2.5)	1.89
lectotype	60	(3.0-)3.1-4.1(-4.8)	3.54	(1.6-)1.7-2.0(-2.1)	1.81	(1.7-)1.8-2.2(-2.5)	1.96
holotype of <i>beschida</i> ^π	30	(3.1-)3.2-4.0(-4.1)	3.49	1.8-2.1	1.93	1.7-2.0(-2.1)	1.81
holotype of <i>farinacea</i> ^π	30	2.9-3.5(-3.8)	3.10	1.6-1.9	1.78	1.6-1.9(-2.0)	1.74
Haikonen 15652	30	(3.4-)3.5-4.2	3.89	1.7-2.1	1.88	(1.8-)1.9-2.2	2.07
Jakobsson 1516	30	3.0-3.6(-3.7)	3.33	1.7-2.0	1.85	1.7-2.0	1.81
Miettinen 7972	30	(2.9-)3.0-3.9(-4.0)	3.29	(1.6-)1.7-1.9	1.75	(1.6-)1.7-2.2	1.87
Niemelä 2788	30	(3.0-)3.1-4.3(-4.6)	3.63	1.7-2.3	1.96	1.7-2.1(-2.4)	1.85
Niemelä 5548	30	3.2-3.8	3.42	1.7-2.1	1.84	1.7-2.0	1.86
Niemelä 6280	30	(3.0-)3.1-3.7(-3.8)	3.32	1.7-2.1	1.92	(1.5-)1.6-1.9	1.73
Niemelä 6705*	30	(3.1-)3.2-3.7(-3.8)	3.41	1.7-2.0	1.84	1.7-2.0(-2.1)	1.85
Niemelä 7363	30	(3.3-)3.5-4.4(-4.6)	3.91	1.8-2.0	1.92	1.8-2.3	2.05
Renvall 3337 ^π	30	3.0-3.5(-3.7)	3.20	1.6-1.9	1.76	1.6-2.0	1.82
Renvall 3360 ^π	31	(2.9-)3.0-3.7(-3.8)	3.17	1.7-1.8	1.76	1.7-2.1	1.80
parasitica	191/6	(3.0-)3.2-4.1(-4.3)	3.63	(2.0-)2.2-2.9(-3.0)	2.50	(1.1-)1.2-1.8(-2.0)	1.45
holotype ^π	30	(3.0-)3.1-3.9(-4.1)	3.48	(2.3-)2.4-3.0	2.67	(1.1-)1.2-1.5(-1.6)	1.30
Dunger 13711	40	(3.2-)3.3-4.0(-4.1)	3.63	(2.1-)2.2-2.8	2.45	(1.2-)1.4-1.7	1.48
<i>exsiccati</i> <i>Vampola</i>	31	(3.2-)3.3-4.2(-4.3)	3.73	2.0-2.7	2.25	(1.3-)1.4-2.0	1.66
<i>Vampola</i> 1886	30	3.2-3.8(4.0)	3.52	2.3-2.8	2.50	(1.2-)1.3-1.6(-1.7)	1.39
<i>Vampola</i> 1899	30	(3.2-)3.3-4.1	3.65	(2.2-)2.3-2.9(-3.0)	2.62	1.3-1.5	1.40
<i>Vampola</i> 1901	30	3.3-4.0(-4.1)	3.77	2.3-2.7(-2.8)	2.51	(1.3-)1.4-1.7	1.50
romellii	371/11	(3.0-)3.4-4.4(-5.1)	3.84	(2.2-)2.3-2.9(-3.1)	2.55	(1.2-)1.3-1.7(-2.0)	1.51
epitype ^π	41	(3.3-)3.4-4.0	3.71	2.3-2.7	2.49	1.3-1.6(1.7)	1.48
Jahn 1970	30	(3.7-)3.8-4.3(-4.4)	4.03	2.5-2.9(-3.0)	2.75	(1.3-)1.4-1.6	1.47
Kinnunen 1120	30	(3.9-)4.0-5.1	4.44	2.3-3.0(-3.1)	2.59	1.6-1.9(-2.0)	1.71
Laurila 9.IX.1937	30	3.2-3.9(-4.2)	3.56	2.2-2.7	2.37	1.3-1.6(-1.7)	1.50
Niemelä 5.IX.1971	40	(3.3-)3.4-4.2(-4.3)	3.97	2.3-2.7(-2.8)	2.56	1.4-1.7	1.55
Niemelä 6095	40	(3.2-)3.3-3.9(-4.0)	3.61	(2.2-)2.3-2.7(-2.8)	2.47	(1.2-)1.3-1.6	1.46
Niemelä 6757	30	4.0-4.5(-4.8)	4.29	(2.4-)2.5-3.0	2.72	1.5-1.7	1.58
Saarenoksa 11587	30	3.6-4.3(-4.4)	3.97	2.4-2.7(-2.8)	2.56	1.4-1.7	1.55
Saarenoksa 24293 ^π	40	3.3-4.0(-4.1)	3.63	(2.2-)2.3-2.7(-2.8)	2.49	1.3-1.6(-1.7)	1.46
Toresson 22.X.1995	30	(3.3-)3.4-4.0(-4.1)	3.80	(2.2-)2.5-2.9(-3.0)	2.71	1.3-1.5(-1.7)	1.40
isotype of <i>subradula</i>	30	(3.0-)3.3-4.1(-4.2)	3.72	2.2-2.6(-2.7)	2.43	(1.2-)1.3-1.7	1.53
subradula	260/6	(3.3-)3.6-5.0(-5.7)	4.12	(1.6-)1.8-2.2(-2.5)	1.95	(1.8-)1.9-2.4(-2.7)	2.11
holotype	60	(3.9-)4.0-5.3(-5.4)	4.59	(1.8-)1.9-2.4(-2.5)	2.09	1.9-2.6(-2.7)	2.20
Niemelä 3278	40	(3.3-)3.8-4.9(-5.7)	4.17	(1.7-)1.8-2.2	1.91	(1.8-)2.0-2.6	2.18
Niemelä 5529	30	3.6-4.5	3.96	1.8-2.2	1.97	1.8-2.2(-2.3)	2.01
Niemelä 6015	30	3.7-4.4(-4.5)	3.98	1.8-2.1	1.98	1.9-2.1(-2.2)	2.01
Niemelä 6899	40	(3.4-)3.6-4.7(-4.8)	3.90	1.7-2.2(-2.3)	1.89	(1.8-)1.9-2.3	2.08
Saarenoksa 18686 ^π	60	(3.5-)3.6-4.7(-5.0)	3.93	(1.6-)1.7-2.0(-2.2)	1.86	(1.8-)1.9-2.4(-2.6)	2.11
subradula	60/1	3.1-3.9(-4.1)	3.49	2.0-2.3(-2.4)	2.18	(1.3-)1.5-1.8(-1.9)	1.60
thompsonii *	60/1	(2.8-)2.9-3.6(-3.8)	3.15	(1.6-)1.7-2.0	1.79	1.6-1.9(-2.0)	1.76

μm , in tube trama subparallel, (2.2–)2.6–3.8(–4) μm , lumen distinct. Cubical crystals sometimes scattered on hyphae. No distinct cystidioles; gloeocystidia prominent, 15–60 $\times$ 4–8 μm , yellow, crowded at tube bottoms and scattered in hymenium deep in the tubes. Basidia with 4 sterigmata. Spores ellipsoid, thin-walled, CB–, IKI–, (3–)3.2–4.4 (–4.7) $\times$ (1.8–)1.9–2.3 μm .

SPECIMENS EXAMINED—**Finland.** Varsinais-Suomi: Tammisaari, 17.X.1976 Niemelä. Uusimaa: Vantaa, 1985 Niemelä 3222. Etelä-Häme: Lammi, 1999 Niemelä 6656. U.S.A. (see type).

—Finnish collections from *Corylus avellana*+*Pseudochaete tabacina*.

Of the studied *Antrodiella* species, Johannesson et al. (2000) found *Antrodiella americana* to be fairly distant from the others. Pores are slightly larger in the type than in European materials, originally 2 per mm, merging together and then 1–1.5 per mm; in Europe the measurements usually give 2–3 pores per mm. Spores of the American material are slightly smaller than in North Europe (Tab. 1), but well within the range and similar in shape. It may be difficult to find enough evidence to split this into two taxa. *Antrodiella americana* is a successor of *Pseudochaete tabacina* (Sowerby) T. Wagner & M. Fisch., usually fruiting on its dead basidiocarps.

Antrodiella canadensis (Overh.) Niemelä

Karstenia 45:75, 2005. *Polyporus canadensis* Overh. in Lowe, Mycotaxon 2:45, 1975.

Holotype: Canada, Ottawa, Dow's Swamp, on spruce stump, 16.IX.1933 Groves 16860 (PAC, studied).

This species was described and illustrated by Niemelä (1985).

SPECIMENS EXAMINED—**Canada** (see type). **Finland.** Kainuu: Suomussalmi, 21.VIII.1993 Anttila. Koillismaa: Salla, 2005 Niemelä 8103. Pohjois-Karjala: Lieksa, 1989 Penttilä 1321.

—Finnish collections from *Pinus sylvestris*.

The complicated nomenclature of this taxon was discussed by Ryvarden & Gilbertson (1984), who renamed it as *Antrodiella overholtsii* Ryvarden & Gilb. because in their opinion the original description was not validly made. Niemelä et al. (2005) accepted the above-listed protologue as valid, and transferred the old name in the genus *Antrodiella*. Johannesson et al. (2000) studied the phylogeny of *P. canadensis* together with several *Antrodiella* species.

Antrodiella citrinella Niemelä & Ryvarden

Karstenia 23:26, 1983. Holotype: Norway, Oslo, *Picea abies* + dead *Fomitopsis pinicola*, 7.X.1982 Ryvarden 20563 (O, isotype H, studied).

The species was described and illustrated by Niemelä & Ryvarden (1983).

SPECIMENS EXAMINED—**Finland.** Etelä-Häme: Lammi, 1989 Renvall 1982. Kittilän Lappi: Kolari, 1999 Niemelä 6640. Pohjois-Karjala, Lieksa, 1989 Penttilä 1223. **Norway** (see type).

—All from *Picea abies*+*Fomitopsis pinicola*.

Antrodiella citrinella is characterised by bright yellow colour, roundish spores, and by its growth on wood previously brown-rotted by *Fomitopsis pinicola* (Sw. : Fr.) P. Karst. The

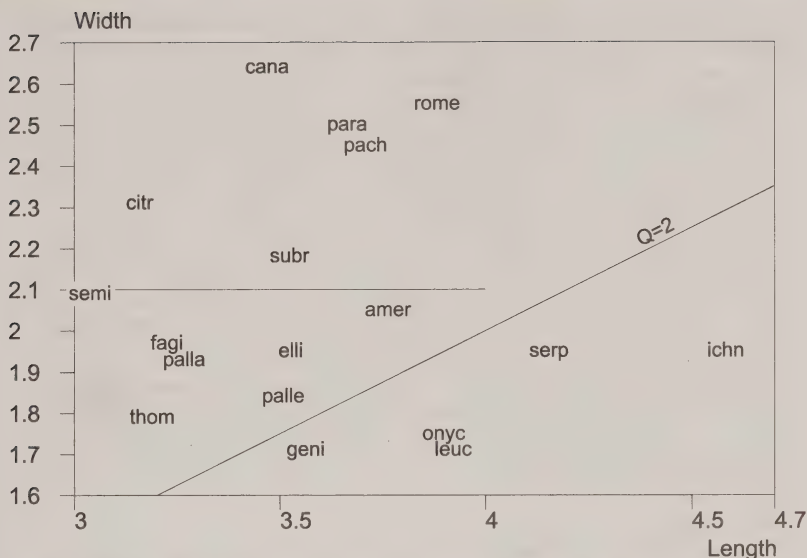


Figure 2. Average spore size of *Antrodiella* species. Species are abbreviated according to 4 to 5 first letters of their epithets. Lines group species into narrow-spored ($Q > 2$), small-spored (width below $2.1 \mu\text{m}$) and wide-spored groups.

commonest host is spruce, but also pine, birch, aspen and alder are accepted, provided that the preceding species was there. Often *A. citrinella* fruits directly on the dead basidiocarps of *F. pinicola*.

***Antrodiella ellipsospora* (Pilát) Niemelä & Miettinen, comb. nov.**

(MB500769)

Basionym: *Leptoporus wynnei* f. *ellipsosporus* Pilát, Bull. Soc. Mycol. France 52:306, 1937. *Leptoporus ellipsosporus* (Pilát) Romagn., Bull. Soc. Mycol. France 60:88, 1944. Lectotype: Russia, Sayany, Arasuk, *Pinus* [*cembra* subsp.] *sibirica*, 1.IX.1932 [B.I.] Krawtzev (PRM 25017, studied). Selected as type by Kotlaba & Pouzar (1989:39).

Pileate, white to cream-coloured, hard when dry. Caps fingernail-shaped, strongly curved when dry, 10 mm wide, up to 2 mm thick, projecting 5 mm, surface matt, margin sharp. Pores 7–9 per mm, orifices entire, walls not appearing fragile. Section: context cream-coloured, hard when dry, tubes concolorous. Dimitic, generative hyphae with clamp connections, $2\text{--}3.2 \mu\text{m}$ in diam., skeletal CB(+), IKI–, interwoven and dominating except close to substrate and tube mouths, in subiculum $(2.6\text{--})3\text{--}3.5\text{--}(3.8) \mu\text{m}$ in diam., in tube trama $2.2\text{--}3\text{--}(3.3) \mu\text{m}$, lumen narrow and indistinct in subicular skeletal, wide to narrow in trama. Basidia with 4 sterigmata, $8.5\text{--}12 \times 3.7\text{--}4.6 \mu\text{m}$. Spores ellipsoid to short cylindrical, thin-walled, CB–, IKI–, $3.2\text{--}4\text{--}(4.1) \times 1.8\text{--}2.1\text{--}(2.3) \mu\text{m}$, ventral side convex, flat, or slightly concave.

SPECIMENS EXAMINED—Russia (see type).

Pilát (1937) described *Leptoporus wynnei* f. *ellipsosporus* from a specimen collected by Krawtzew from *Pinus cembra* subsp. *sibirica* in Siberia. Romagnesi (1944) raised the form to species rank as *Leptoporus ellipsosporus*. Kotlaba & Pouzar (1989) and Ryvarden & Gilbertson (1994: 696) showed the type to belong to the *Antrodiella semisupina* complex; they also discussed the complicated nomenclature of this taxon. We restudied the lectotype. It is small and young but in a rather good condition. Substrate is strongly brown-rotted gymnosperm wood, *Pinus sibirica* according to the label, supported by microscopic analysis (by Pirkko Harju, H). Macroscopy, gymnosperm host and spore size point towards *Antrodiella pallasii*, but that species has shorter, uniguttulate spores, narrower skeletal with distinct lumen in subiculum, and it is a follower of *Trichaptum abietinum* (Pers. : Fr.) Ryvarden, a white-rot fungus. *Antrodiella faginea* has clearly shorter and more ellipsoid spores and it grows on angiosperms. *Antrodiella pallescens* comes closest microscopically; its spores are slightly narrower and more uniformly straight cylindrical. Ecology is different: *A. pallescens* is restricted to angiosperm hosts and follows *Fomes fomentarius*, which is a white-rot fungus. We accept Pilát's taxon as a good species, and hence make the necessary combination. Yet new material is needed to establish the identity of this species.

Antrodiella faginea Vampola & Pouzar

Czech Mycol. 49:25, 1996. Holotype: Czech Rep., Moravia: Jihlava, Zborná, Ptačí vrch, alt. 637 m, *Fagus sylvatica*, 5.VII.1990 Vampola (PRM 842925, studied).

= ?*Antrodiella micra* Y.C. Dai, Mycotaxon 89:393, 2004. Holotype: China, Jilin, Antu, Changbaishan Nat. Res., *Populus+Phellinus gilvus*, 19.IX.1998 Dai 2998 (IFP, not studied).

Annual, pileate, effused-reflexed or resupinate, leathery, when dry hard. Caps fingernail-shaped, spatulate, flabelliform or even substipitate, 5–20 mm wide, up to 3 mm thick, projecting 2–20 mm, surface matt, cream-coloured, light ochraceous yellow or even greyish, somewhat hygrophanous, margin sharp and often incised; resupinate area 10–150 × 5–40 mm, roundish or ellipsoid, neighbouring areas later merging together. Pores cream-coloured, sometimes with purple-greyish patches at older centre and close to the attachment, (5–)6–8 per mm, orifices entire. Section: context cream, homogeneous, when dry hard, tubes concolorous. Dimitic, generative hyphae with clamps, skeletal CB(+), IKI– or faintly amyloid in tube trama, KOH–, in context/subiculum radially subparallel, (2.4–)2.7–4.2(–5.5) µm in diam., in tube trama tightly interwoven but not agglutinated, (1.8–)2.3–3.2(–4) µm, lumen wide to narrow in context skeletal, indistinct in subiculum, capillary in trama. Crystal clusters seen in between hyphae; occasional hyphal pegs. Cystidioles with conical apex; gloeocystidia 9–18 × 3.6–6 µm, sometimes common, in other specimens occasional or evidently absent, weakly differentiated, resembling juvenile basidia, often present at tube bottoms in old hymenium. Basidia with 4 sterigmata. Spores ellipsoid, thin-walled, CB–, IKI–, (2.5–)2.8–3.7(–4.5) × (1.6–)1.8–2.2(–2.5) µm, sometimes tapering to proximal apex, ventral side flat or a little convex.

SPECIMENS EXAMINED—China. Jilin: Antu, Changbai, *Acer*, 1993 Dai 1077; *Betula*, 1993 Dai 1074. Czech Rep. (see *type). Finland. Uusimaa: Helsinki, *Populus+Phellinus punctatus*, 1985 Erkkilä 535; *Salix+P. punctatus*, 1986 Saarenokska 18786;

Salix+*Pseudochaeta tabacina*, 1994 Saarenoksa 9694. Sipoo, *Alnus*, 1985 Saarenoksa 10185; *Betula*, 1987 Saarenoksa 26687; *Populus*, 1993 Saarenoksa *8093; *Salix*+*P. punctatus*, 1985 Saarenoksa 11185; *Sorbus*+*P. punctatus*, 1984 Saarenoksa *34384. Kirkkonummi, *Corylus*+*P. punctatus*, 1985 Saarenoksa 12995. Tuusula, *Corylus*+*Inonotus radiatus*, 1987 Saarenoksa 21687. Vantaa, *Prunus*, 1993 Renvall *3217; *Salix*+*P. conchatus*, 18.IX.2003 Savola. Etelä-Häme: Lammi, *Populus*, 1993 Renvall *3347. Pohjois-Karjala: Ilomantsi, *Betula*+*Pycnoporus cinnabarinus*, 2003 Penttilä 14342. Kainuu: Kuhmo, *Populus*, 1998 Miettinen *330, 373, 460, 495, *500, 599, 612, 623, 691; +*Phellinus tremulae*, 355, *365, 517, *674, 693, 723; +*Phellinus populicola*, *444, *600; +*Inonotus rheades*, *458. Oulun Pohjanmaa: Oulu, *Alnus*, 2001 Kulju *7001. Kittilän Lappi: Kittilä, *Salix*+*P. conchatus*, 2000 Niemelä 6867. Sweden. Torne Lappmark: Jukkasjärvi, *Betula*, 1910 Romell 14658 (S). Ukraine. Zakarpats'ka Oblast: Delovoye ("Trebušany"), *Fagus*, 1937 Pilát (H ex PRM 488786).

—Specimens marked with an asterisk (*) bear gloeocystidia.

Antrodiella faginea resembles *A. pallescens*, but the former is more commonly effused and pilei are thinner or spatulate. Hyphal structure is identical, but spores are thicker and often shorter (Figs. 1 and 3), with convex to straight ventral side, not concave like in *A. pallescens*; different shapes are seen in the Q values (Fig. 4). In the study of Johannesson et al. (2000) these two species were clearly separated on the basis of their ITS sequences.

Spore size of *A. faginea* comes also close to *A. pallasii* (Fig. 2), which grows on gymnosperms rotten by *Trichaptum*, and has slightly smaller spores and narrower subicular skeletal. Basidiocarps of the latter are yellowish, and tubes tend to split and therefore have lacerate orifices. *Antrodiella semisupina* sensu stricto resembles *A. faginea* as well, and their identities should be reconsidered when the American taxon becomes better known.

Antrodiella faginea is rather common throughout Finland. It is found in a wide variety of biotopes, ranging from small branches of deciduous trees in herb-rich forests in the hemiboreal southern coast, to aspen trunks in old-growth forests of boreal North Finland. The shape ranges from substipitate to strictly resupinate, and the occurrence of gloeocystidia in the basidiocarps varies. Consequently, it was suspected that several species might be involved, and detailed microscopic studies were made on the Finnish collections and Central European type material. We found no support of the existence of several species: there was no covariance between the area of occurrence, ecology, growth habit, or microscopy of the studied specimens. Johannesson et al. (2000) found Czech specimens to have identical to almost identical ITS sequences with Finnish specimens.

It also became clear that gloeocystidia are an unreliable character for identification purposes, since only 15 out of 38 specimens studied in detail bore them. Even if present they are usually inconspicuous and difficult to observe. One of the specimens (Renvall 3217) sequenced by Johannesson et al. (2000) and found to belong to *A. faginea* had practically no gloeocystidia whereas two others, including the type, bore plenty of them.

Antrodiella faginea seems to be a successor species of some *Hymenochaetaceae* species, most commonly *Phellinus conchatus* (Pers. : Fr.) Quél., *P. punctatus* (P. Karst.) Pilát and *P. tremulae* (Bondartsev) Bondartsev & P.N. Borisov. The author O.M. found it much more commonly from trunks with *P. tremulae* than any other polypore species

in his study of over one thousand aspen trunks in Central Finland. Yet many finds show no connection to species of *Hymenochaetaceae*, and the link to a preceding species is evidently weaker than in, for instance, *A. pallescens* or *A. citrinella*.

Antrodiella micra was described from China (Dai 2004) as a species related to *A. faginea* but lacking gloeocystidia and being resupinate. These variable characters may not suffice for the separation of a species. Moreover, the growth on *Phellinus* fits well with *A. faginea*. We propose that *A. micra* represents *A. faginea*. The Chinese *faginea* specimens reported here are pileate and agree well with European material, although having a slightly larger average spore size.

***Antrodiella ichnusana* Bernicchia, Renvall & Arras**

in Bernicchia, *Polyporaceae* s.l.: 127, 2005. Paratypes: Italy, Sardinia, Arzana (Nuoro), Villagrande, *Alnus glutinosa*, 30.XI.2003 Bernicchia & Arras 7694, 7695 (H ex KUO & HUBO, studied).

Annual, resupinate, soft leathery, when dry hard, basidiocarps 15–30×8–15 mm, irregularly roundish, usually emerging solitarily. Sterile margin narrow, fibrous, in young specimens hygrophanous. Pores (3–)4–5(–6) per mm, when fresh cream-coloured and hygrophanous, when dry dark cream-coloured or tan; orifices entire. Section: subiculum cream-coloured, tubes concolorous. Dimitic, generative hyphae with clamps, skeletal uniform, CB(+), IKI–, KOH–, interwoven in all parts but not agglutinated, 2–3.2 µm in diam. Crystal clusters sometimes present in between hyphae; no distinct cystidioles or gloeocystidia. Basidia with 4 sterigmata. Spores cylindrical, straight or a little drooping at apicular end, thin-walled, CB–, IKI–, (3.9–)4–5.1(–5.4)×(1.7–)1.8–2.1(–2.2) µm.

SPECIMENS EXAMINED—**Finland.** Uusimaa: Helsinki, 1993 Haanpää 1023, 1324, 1325; 1993 Niemelä 5671; 1987–1995 Saarenoksa 6992, 8390, 8491, 9295, 9391, 9490, 9594, 9991, 10291, 10591, 11090, 11695, 12791, 13892, 15790, 16190, 16290, 16390, 19792, 30190. Sipoo, 1990–1995 Saarenoksa 5195, 12395, 26390; 2004 Niemelä 7743. **France.** Sardinia, Nuoro: Lago Alto Flumendosa, 2000 Ryvarden 43171 (O, H). Savoie: Valmorel, *Acer*, 5.XI.1997 Pieri. **Italy** (see types). **Netherlands.** Zuid-Holland: Oostvoorne, *Quercus*, 1963 Donk 12501 ("*Poria romellii*", L 963.243123).

—Host *Alnus*, unless otherwise indicated. Only selected specimens are listed from Finland.

The species was described recently from Italy (Bernicchia 2005). However, the existence of this taxon was well known in Finland since the second half of the 1980s. Mr Reima Saarenoksa (Helsinki) collected it repeatedly and made field observations in seaside alder forests around Helsinki. Those annotated materials were preserved in the Botanical Museum of the University of Helsinki under the provisional name '*Antrodiella alni* Saarenoksa', referring to its growth on *Alnus glutinosa*. Growth sites are moist seaside forests with rich mull or mud soil and dense and tall field layer of *Filipendula*, *Aegopodium*, *Urtica*, *Equisetum*, *Lysimachia*, *Rubus*, etc. In addition to *Alnus*, also *Prunus padus*, *Salix caprea*, *Sambucus racemosa*, *Acer platanoides*, and scattered birch and spruce grow in the area. Basidiocarps develop on thin (1–2 cm diam.) fallen branches. These field notes were compiled from herbarium labels and personal discussions with Reima Saarenoksa, of which we are grateful. At present, the species is known in Finland only along the southern coastline of the metropolitan area. Records from France and the Netherlands are new.

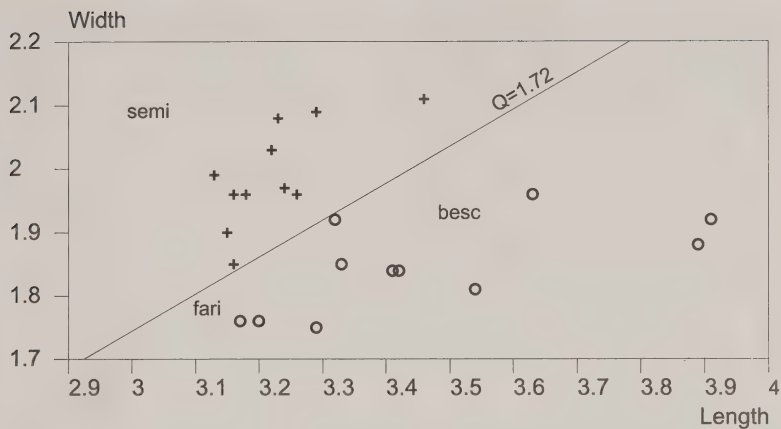


Figure 3. Average spore sizes of individual specimens of *A. faginea* (+), *A. pallescens* (O), *A. semisupina*, *A. farinacea* and *A. beschidica* (abbreviated by their epithets).

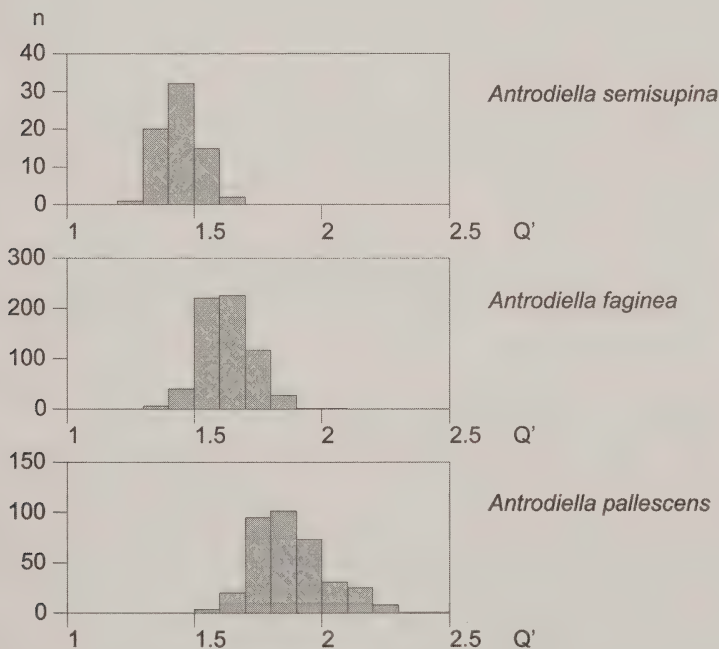


Figure 4. Histograms of Q' values (length/width ratio of individual spores) of three closely related *Antrodiella* species (n =number of spores).

At first sight *A. ichnusana* resembles very much *A. romellii*, and often the two are collected side by side in the same habitats. In the field, the species is separated from *A. romellii* by its larger pores. Under the microscope, the striking difference is the cylindrical spore shape of *A. ichnusana*, versus broadly ellipsoid in *A. romellii* (Fig. 1).

***Antrodiella leucoxantha* (Bres.) Miettinen & Niemelä, comb. nov.**

(MB500772)

Basionym: *Polyporus leucoxanthus* Bres., Mycologia 17:73, 1925. **Lectotype** (designated here): U.S.A., Virginia, Great Falls, on *Robinia pseudoacacia*, 23.IX.1921, coll. J.R. Weir 21127, det. G. Bresadola (BPI US0211632, studied).

= *Coriolus hoehnelii* subsp. *genistae* Bourdot & Galzin, Bull. Soc. Mycol. France 41:145, 1925. *Coriolus genistae* Bourdot & Galzin, Bull. Soc. Mycol. France 41:145, 1925. **Lectotype**: '*Coriolus genistae* nob., sur genêt, bois de pins, environs d'Épinal (Vosges), XII.1904, leg. Galzin, det. H. Bourdot' (herb. Bourdot 3975, PC, studied). Selected as type by Donk (1974:264).

Annual, pileate with minute caps, 4–10 mm wide, projecting 3–5 mm from wood, 1–2 mm thick at base, downcurved, when fresh white, when dry cream or straw-coloured and hard, smooth and matt above, margin sharp. Pores round, 5–6(–7) per mm, orifices regular, not denticulate. Section: context and subiculum white, tubes cream-coloured. Hyphal system dimitic, generative hyphae with clamps, thin-walled, skeletals dominating in all parts, thick-walled and with a distinct lumen, in context/subiculum (2.1–)2.6–4 (–5.6) μm in diam., in tube trama (2–)2.5–3.3(–3.7) μm , IKI– or slightly amyloid, CB(+), KOH–. Gloeocystidia mostly absent, sometimes present, 13–21 $\times$ 5.5–9 μm , clavate, distinct but not prominent; cystidioles like basidioles but with a tapering, fairly blunt apex. Basidia with 4 sterigmata. Spores narrow, cylindrical, thin- and smooth-walled, IKI–, CB–, (2.9–)3.2–4.5(–5.6) $\times$ 1.5–1.9(–2.1) μm , almost always clearly curved with concave ventral side.

SPECIMENS EXAMINED—**Czech Rep.** Bohemia: Karlštejn, *Quercus*, 1996 Landa (PRM *889755). Roztoky, *Quercus*, 1996 Pouzar (PRM 890582). Zbořený Kostelec, *Quercus*, 1980 Kotlaba (PRM 871821). **Finland.** Uusimaa: Helsinki, *Populus*, 1989 Saarenoksa 58589. Keski-Pohjanmaa: Nykarleby, *Betula*, 1994 Jakobsson *918. Raahe, *Betula*, 1993 Särkkä 50. **France** (see type of *C. genistae*). **Slovakia.** Kalná Roztoka, *Fagus*, 1987 Kotlaba & Pouzar (PRM 854493). **U.S.A.** (*lectotype & same data BPI US0211634).

Excluded from the description above: 'Rossia, Wasilienka, *Polyporus leucoxanthus* Bres., on *Populus tremula*' (BPI US0211633). * = gloeocystidia observed.

Ryvarden (1988) showed *Polyporus leucoxanthus* to belong to the *Antrodiella semisupina* complex. Original collections in BPI include three packages, all marked as syntypes. Two of them (US0211632 = Weir 21127, and US0211634) are Weir's collections from *Robinia pseudoacacia* in Virginia, U.S.A., and one from *Populus tremula* in "Rossia, Wasilienka", now possibly Ukraine. The excluded syntype, with scanty spores, may represent *Antrodiella pallescens*.

US0211632 (Weir 21127) was the only specimen mentioned by number in Bresadola's (1925) description, and, even though small, it is in good condition and fertile. Annotations show that this was the specimen that Ryvarden (1988) examined for his type studies. Therefore it is here selected as the **lectotype** of *Polyporus leucoxanthus*.

US0211634 is obviously its duplicate, and similar in all respects. The lectotype specimen is indisputably an *Antrodiella*, characterised by small spores, dimitic hyphal structure and faintly cyanophilous skeletal hyphae. Spores are too narrow for the American *Antrodiella semisupina*, and too curved for *A. pallescens* (Fig. 1). Nothing points towards any other preceding fungus. *Robinia* is not mentioned as a host of *Fomes fomentarius* (predecessor of *Antrodiella pallescens*) or *Inonotus radiatus* (Sowerby: Fr.) P. Karst. (predecessor of *Antrodiella serpula*) (Gilbertson & Ryvarden 1986, Ryvarden & Gilbertson 1993), and it is fairly sure that neither *Fomes* nor *Inonotus* was growing on the tree.

Spores in the lectotype remind those of *Antrodiella onychoides*, *A. ichnusana* (a strictly resupinate species with larger pores, spores almost straight), and also *A. genistae* and *A. serpula* (= *A. hoehnelii*, see later), although they are usually longer in the last-mentioned species. Cap surface of *A. serpula* is rough with warts sharp to touch, while it is smooth in the present lectotype specimen. The minute pilei of the lectotype are perfectly developed with good tubes and sharp edge; in *A. serpula* such small pilei are juvenile nodules only, and its fully developed basidiocarps are more robust. Skeletal hyphae of *A. serpula* are thicker than in *A. leucoxantha*. For these reasons we don't consider them to be conspecific.

The identity versus *A. genistae* needed a detailed study. Spores are slightly longer in *A. leucoxantha*. Pore size is the same, and no striking differences were found in the other characters. When further European collections were studied, the differences in spore size became less significant: all transitions were present, and spore measurements in North European collections were even closer to the American type (*leucoxantha*) than to the European one (*genistae*). So the slight difference between *A. genistae* and *A. leucoxantha* does not run along the continents. The material of this taxon was the most heterogeneous among the studied taxa, deserving further study.

The two names were published the same year, but *P. leucoxanthus* has priority (the March–April issue of *Mycologia* vol. 17, 1925) over *P. genistae* (second issue of *Bull. Soc. Mycol. France* vol. 41, 1925, date of publication 1 Sep 1925).

Antrodiella onychoides is strikingly similar to this species, e.g. in its spore characteristics. Ryvarden & Gilbertson (1993) suggested that *A. onychoides* may be just a haploid form of *A. genistae*.

Antrodiella onychoides (Egeland) Niemelä

Karstenia 22:11, 1982. *Polyporus onychoides* Egeland, *Nyt Mag. Naturvidensk.* 51:92, 1913.

Holotype: 'Polystictus onychoides Egel. n. sp., [Norway,] Vestre Aker: Ekely, *Fraxinus*, 26.XII.1912' (O 55295, studied).

Annual, pileate with minute caps or effused-reflexed, 4–35 mm wide, projecting 3–7 mm from wood, 1–2 mm thick at base, downcurved, white to cream-coloured, smooth and matt above, margin sharp, when dry hard. Pores round, 5–8 per mm, orifices regular, not denticulate. Hyphal system dimitic, generative hyphae without clamps, thin- to slightly thick-walled, skeletal dominating in all parts except upper subiculum, thick-walled and with distinct lumen, in context/subiculum (2.2–)3.1–4(–4.6) μm in diam., in tube trama (2.5–)2.9–3.4(–4) μm , IKI– or slightly amyloid, CB(+), KOH– or swelling. No cystidia. Basidia with 4 sterigmata. Spores narrow, cylindrical, thin- and smooth-walled, IKI–, CB–, (2.9–)3.2–4.5(–5.6) $\times$ 1.5–1.9(–2.1) μm , curved with a concave ventral side.

SPECIMENS EXAMINED—**Finland.** Uusimaa: Helsinki, *Betula*, 1985 Niemelä 3227; *Alnus*, 1991 Saarenoksa 24791; *Salix/Alnus*, 1991 Saarenoksa 45791. Satakunta: Hämeenkyrö, *Prunus padus*, 26.X.2000 Salonen. **Norway** (see type).

Antrodiella onychoides is the only consistently clampless *Antrodiella* species described so far. It reminds closely *A. leucoxantha* in its ecology (usually on branches of angiosperms in fertile habitats), macroscopy (small, whitish, pileate basidiocarps) and microscopy (the only difference being in generative hyphae). Relationships of these taxa would deserve further study; *Polyporus onychoides* is their oldest name, although we consider synonymy of these names unlikely. The sometimes reminiscent *A. pallescens* differs in not having clearly curved spores, and its subicular skeletal hyphae have an indistinct lumen.

Antrodiella pachycheiles (Ellis & Everh.) Miettinen & Niemelä, **comb. nov.**

(MB500774)

Basionym: *Polyporus pachycheiles* Ellis & Everh., Proc. Acad. Nat. Sci. Philadelphia 1894:322, 1894. **Lectotype** (designated here): '*Polyporus pachycheiles*', [U.S.A., Jew Jersey, *Acer rubrum*, Nov. 1893] (NY, isoelectotype BPI US0305581, both studied).

Basidiocarps pileate, flabelliform, spatulate or floriform, with constricted base, 1–1.5 cm wide, 2–3 mm thick, projecting ca. 1 cm from substrate, dry pilei downcurved. Upper surface matt with minute radial streaks, light ochraceous yellow; bruised margin apricot, chestnut or dark brick-coloured, margin sharp. Poroid surface pale ochraceous or dark cream, pores round and very small, 7–8(–9) per mm, orifices regular. Section: context cream-coloured, tubes cream to tan. Hyphal system dimitic; generative hyphae clamped and thin-walled, skeletal hyphae dominating in all parts, flexuous, translucent, with indistinct lumen, in context thick, (2.5–)3.6–4.6(–5.6) μm , in trama (2.6–)2.9–3.7(–4.3) μm in diam., thick-walled, IKI–, CB(+), and swelling (commonly >6 μm) and in some areas dissolving in KOH, subparallel in context, and interwoven but not agglutinated in tube trama. Thin-walled hymenial cystidia found irregularly, mostly slightly subulate and projecting a little, 10–14.5 $\times$ 3.4–4.6 μm ; angular crystals common among the hyphae. Basidia with 4 sterigmata. Spores ellipsoid, thin-walled, CB–, IKI–, (3.1–)3.2–4.3(–4.4) $\times$ (2–)2.2–3.1 μm , ventral side straight or more often a little rounded, never concave; no guttulae.

SPECIMENS EXAMINED—U.S.A. (see type).—Omitted from the description above, but good specimen of the species: '*Polyporus pachycheiles?*, U.S.A., Vermont, Newfane, [cf. *Betula*], 4.IX.1917 A. Hibbard 18995' (BPI US0305580).

Ellis & Everhart (1895) mention only one specimen in their description of *Polyporus pachycheiles*. Specimens matching the description are found in NY and BPI. The former is larger, in good condition, and was considered as the type by Lloyd. Thus the specimen in NY is selected as the **lectotype** of *Polyporus pachycheiles*. The specimen in BPI is evidently its duplicate, and its character data has been combined with the lectotype when making descriptions.

Polyporus pachycheiles has usually been reduced to the synonymy of *A. semisupina* (Overholts 1953, Lowe 1975, Gilbertson & Ryvarden 1986). However, *Polyporus pachycheiles* can be separated from *A. semisupina* sensu typi and *A. pallescens* by several macro- and microscopic characters. In our opinion, this is a well-defined species within

the genus, characterised by flabelliform shape, fairly bright colours, and small pores. In the microscope it stands out among similar other species by the large spores (about the size of *A. romellii*, which is resupinate) and the skeletal hyphae that swell strongly and even dissolve in KOH. The lectotype bears in places thin-walled hymenial cystidia that do not stain any differently from the rest of the hymenium in IKI or CB. In specimen 0305580, there are pear-shaped, vesicular cystidia in the hymenium, probably just a secondary feature of a senescent basidiocarp.

***Antrodiella pallasii* Renvall, Johannesson & Stenlid**

Mycol. Research 104: 95, 2000. Isotype: Finland, Sompion Lappi, Savukoski, *Picea abies*, 25.VIII.1992 Renvall 2990 (H, studied).

Annual, effused-reflexed or resupinate, light yellow when young, white when old and then often with violet-grey patches, tough but thin and appearing fragile when young, hard when dry. Caps fingernail-shaped, typically in rows of up to 20 cm, single caps 5–20 mm wide, projecting 2–10 mm, up to 2 mm thick; resupinate area 5–100 mm across, neighbouring areas later merging together, sterile margin distinct, white. Pores (5–)6–8 per mm, orifices finely toothed. Section: context/subiculum white to cream-coloured, usually less than 1 mm thick, tubes cream to yellowish, tube layer 0.5–2 mm. Dimitic, generative hyphae with clamps, skeletal CB– to CB(+), IKI– or faintly amyloid, KOH–, in subiculum (1.8–)2.7–3(–3.7) μm in diam., in tube trama subparallel, (2–)2.3–2.9(–3.2) μm , lumen capillary and visible or indistinct in subiculum, wide in trama, structure appearing almost monomitic in lower trama. Crystal clusters among hyphae common, oily substance present as small droplets. No cystidia or cystidioles seen. Basidia with 4 sterigmata. Spores ellipsoid, thin-walled, CB–, IKI–, (2.9–)3–3.7(–3.9) $\times$ (1.6–)1.8–2.1(–2.3) μm , ventral side typically flat, sometimes a little convex or concave, often with an oil drop.

SPECIMENS EXAMINED—**Finland.** Perä-Pohjola: Rovaniemi, *Picea*, 1960 Eriksson 9416 (UPS). Kittilän Lappi: Kittilä, *Picea*, 1980–2001 Niemelä 2143, 6580; *Pinus*, Niemelä 7139. Kolari, *Picea*, 1999 Niemelä 6617. Sompion Lappi (see type).

—All on dead *Trichaptum abietinum*.

Antrodiella pallasii is a strict follower of *Trichaptum abietinum* and possibly other *Trichaptum* species. It is well defined by small spores, narrow skeletal hyphae and gymnosperm hosts. *Antrodiella parasitica* is similarly associated with *T. abietinum*, but has much wider spores. Spore size of *A. pallasii* comes close to *A. faginea*, which is found on angiosperm hosts and has clearly thicker skeletal hyphae. Gymnosperm-associated *A. ellipsospora* has slightly wider spores and thicker skeletal hyphae.

***Antrodiella pallescens* (Pilát) Niemelä & Miettinen, comb. nov.**

(MB500770)

Basionym: *Coriolus pallescens* Pilát, Bull. Soc. Mycol. France 48:15, 1932. Lectotype: Sweden, Torne Lappmark: Jukkasjärvi, Björkliden, *Betula*, 1.IX.1909 Romell 14653 (S, studied). Selected by Ryvarden (1974:279).

= *Antrodiella beschidica* Vampola & Pouzar, Czech Mycol. 49:23, 1996. Holotype: Czech Republic, Moravia, Moravskoslezské Beskydy, Jablunkov, *Abies alba*, 7.IX.1969 Pouzar (PRM 682098, studied).

= *Antrodiella farinacea* Vampola & Pouzar, Czech Mycol. 49:29, 1996. Holotype: Slovakia, Banská Bystrica, Badín, *Ulmus glabra*, 30.IX.1994 Vampola (PRM 842927, studied).

Annual, pileate, effused-reflexed or resupinate, leathery, when dry hard. Caps shelf- or fingernail-shaped, 10–40 mm wide, up to 5 mm thick, projecting 5–30 mm, surface matt, cream-coloured, often with faint tan or mouse grey zones or greyish all over, margin sharp; resupinate area 20–100×10–50 mm, roundish or ellipsoid, neighbouring areas later merging together. Pores cream-coloured, (4–)6–8 per mm, orifices entire. Section: context cream-coloured, homogeneous, when dry hard, tubes concolorous. Dimitic, generative hyphae with clamp connections, 2.3–3.3 µm, skeletal CB(+), IKI–, in context/subiculum radially subparallel, (2–)3–4.6(–5.4) µm in diam., in tube trama tightly interwoven but not agglutinated, (2–)2.4–3.2(–4.1) µm, lumen wide to narrow in context skeletal, indistinct in subiculum, capillary in trama. Crystal clusters occasional. Cystidioles poorly differentiated with conical apex; gloeocystidia mostly absent but seen in one specimen; hyphal pegs present. Basidia with 4 sterigmata. Spores short cylindrical or ellipsoid, thin-walled, CB–, IKI–, (2.9–)3–4.1(–4.8)×(1.6–)1.7–2(–2.3) µm, rarely tapering, ventral side flat or (longest spores) a little concave.

SPECIMENS EXAMINED—Czech Rep. (type of *A. beschidica*). Finland. Uusimaa: Mäntsälä, *Betula*, 1993 Haikonen 15652. Etelä-Häme: Kuru, *Betula*, 2003 Miettinen 7972. Koski, *Betula*, 1982 Niemelä 2788. Lammi, *Betula*, 1993 Renvall 3338; *Alnus*, 1993 Renvall 3360. Keski-Pohjanmaa: Nykarleby, *Betula*, 1995 Jakobsson 1516. Pohjois-Karjala: Lieksa, *Betula*, 1991 Niemelä 5548. Sompion Lappi: Sodankylä, *Betula*, 1998 Niemelä 6280. Kittilän Lappi: Kittilä, *Betula*, 2000 Niemelä *6705. Perä-Pohjola: Rovaniemi, *Alnus*, 2003 Niemelä 7636. Slovakia (type of *A. farinacea*). Sweden (see type).

—All Finnish collections with *Fomes fomentarius*. * = gloeocystidia observed.

Finding a name for the *Antrodiella* species growing on dead basidiocarps of *Fomes fomentarius* turned out to be a nomenclatural puzzle. The names *Polyporus pachycheilus* (Ellis & Everhart 1895), *P. leucoxanthus* (Bresadola 1925) and *Trametes subscutellata* (Murrill 1910) have been referred to the *A. semisupina* complex (Murrill 1907, Lowe 1975, Overholts 1953, Ryvarden 1985, 1988); we studied their types and prefer to keep them separate.

The name *Polyporus pallescens* was used from time to time for the European '*Antrodiella semisupina*'. Originally *P. pallescens* Fr. : Fr. (Fries 1818) was a name for the species that is now known as *Bjerkandera fumosa* (Pers. : Fr.) P. Karst. (Donk 1974). Karsten (1881a) transferred the epithet to his newly described genus *Tyromyces* as *T. pallescens* (Fr. : Fr.) P. Karst., and later the same year (Karsten 1881b) he created still another combination, *Bjerkandera pallescens* (Fr. : Fr.) P. Karst. These were mere technical new combinations of the old Friesian name, without descriptions or comments on the identity of the species.

Karsten's herbarium (in H), however, reveals that his concept of the taxon changed in the course of time (Lowe 1956), and it seems that in his later years Karsten abandoned to use the epithet for *Bjerkandera fumosa*, and coined it to the European '*A. semisupina*'. He also sent a specimen (Lowe 1956:119) of this kind to Romell in Stockholm (S). That, and own collections from Swedish Lapland, prompted Romell (1911) to describe a new species, *Polyporus pallescens* Romell ('*P. pallescens* Karst.') for the fungus growing on dead *Fomes fomentarius*. The description is clear, specimens good for typification are

listed, and *P. pallescens* Fr. : Fr. is excluded. All the elements for a good description of a new species were there, except the unfortunate name which is a homonym of *Polyporus pallescens* Fr. : Fr.

Pilát (1932) seems to be the first to transfer *Polyporus pallescens* Romell to a new genus. In that paper the following subheading is found: “**Coriolus pallescens** Karsten, sensu Romell, Hymen. of Lappl., p. 19, nec Fries! f. *resupinata* m[ihi]” [bold face and italics original]. Then description of the resupinate form follows, and a Siberian specimen from *Salix* is listed (coll. Ziling 233). By doing this, Pilát in fact validated the Romellian *pallescens* by creating the nomen novum *Coriolus pallescens* Pilát, based on the description and collections of Romell and, via Romell, also of Karsten; simultaneously he described a new form from Siberian material. The correct citation is *Coriolus pallescens* Pilát, rather than Karsten (who did not describe the species but only sent a specimen so named to Romell) or Romell (who was not mentioned as the author in Pilát's description; ICBN (St Louis) Art. 46.4).

Consequently, the identity of *Coriolus pallescens* Pilát should be searched from the collections by Romell and/or Karsten. Fortunately good specimens exist. In Helsinki (herb. H) there are two such specimens—Herb. Karsten nos. 718 and 1846, both of which agree with the present species concept. In Stockholm (S) there are several specimens collected by Romell from Swedish Lapland; Ryvarden (1974) selected one of them as lectotype. That material is good quality and a typical representative of the species.

Antrodiella beschidica was described in Vampola & Pouzar (1996) from material collected from *Abies alba*. In spite of this unusual host, we consider this to be *A. pallescens*, as was already done by Johannesson et al. (2000) on the basis of identical ITS sequences. Spores and other microscopy agree in these two materials. *Fomes fomentarius*, the predecessor of *A. pallescens*, occasionally grows on *Abies alba*, but no such link was mentioned in the holotype collection.

Antrodiella farinacea was described from Slovakia from an elm tree (Vampola & Pouzar 1996). Type material consists of young, effused-reflexed basidiocarps with fingernail-shaped pilei. The nearly lacrymoid spores would match better with *A. faginea*, but spores typical of *A. pallescens* were also present. In the study of Johannesson et al. (2000), this grouped clearly among *A. pallescens*.

Anrodiella pallescens is very similar to *A. faginea*. Aside slightly different ecology, the only clear difference is in the spores, which are in *A. faginea* ellipsoid, never cylindrical, and have higher Q^+ -values (Figs. 1, 3 & 4).

Antrodiella parasitica Vampola

Česká Mykologie 45:10, 1991. Holotype: Czech Republic, Moravia: Řásná, NW of Telč, alt. 675 m, *Picea abies*, on living basidiocarps of *Trichaptum abietinum*, 10.V.1990 Vampola (PRM 842842, studied).

Annual, strictly resupinate, leathery, when dry brittle hard, basidiocarps small, mostly 5–15×5–30 mm, patchy, gregarious on living or recently dead *Trichaptum*. Sterile margin narrow to absent. Pores (4–)5–6(–7) per mm, cream-coloured; orifices entire or a little lacerate. Section: subiculum cream-coloured, tubes concolorous. Dimitic, generative hyphae mostly with clamps but simple septa also seen, skeletal rather uniform, CB(+), in places weakly amyloid, KOH–, interwoven in all parts, but not agglutinated, (2.1–)2.5–

3.3(–3.8) μm in diam, with a variably visible lumen. Crystal clusters sometimes present in between tramal hyphae; no distinct cystidioles or gloecystidia. Basidia with 4 sterigmata. Spores ellipsoid or even subglobose, thin-walled, CB–, IKI–, (3.2–)3.3–4 (–4.1) $\times$ (2.2–)2.3–2.9(–3.2) μm , ventral side convex.

SPECIMENS EXAMINED—Czech Rep. Moravia: Radostín, Vampola 1899; Polyp. Exs. Čechosl. 39. Řásná (see type). Loučky, 1990 Vampola 1886. Komárovice, 1990 Vampola 1901. Finland. Uusimaa: Sipoo, 1995 Jakobsson 1247. Germany. Sachsen: Oderwitz, 1984 Dunger 13711.

—All on *Picea abies*+*Trichaptum abietinum*.

Basidiocarps of this species are completely resupinate and typically very small. The species name is well selected, because *A. parasitica* mostly grows on still-living basidiocarps of *Trichaptum abietinum*. Vampola (1991) described *A. parasitica* from an extensive Central European material as having broadly ellipsoid spores and bearing gloecystidia. We were unable to find gloecystidia in specimens of *A. parasitica* despite extensive search. The hymenial cells of the species are big and stain fairly strongly in CB and IKI, especially the young basidia, which also project somewhat above the hymenium. These cells may be mistaken for gloecystidia, but a careful examination reveals that some of them bear sterigmata and in fact do not stain differently from the other hymenial cells. Even without gloecystidia, the species is rather easy to identify based on its spore characters and ecology. The type specimen is mostly clamped, but bears frequent simple septa especially in the hymenium. This is untypical for most *Antrodiella* species. One Finnish specimen (Jakobsson 1247) is clampless throughout, but agrees otherwise with the Central European material. Is the presence or absence of clamps less determining for this species than for most other *Antrodiella*?

Antrodiella romellii (Donk) Niemelä

Karstenia 22:11, 1982. *Poria romellii* Donk, Persoonia 5:84, 1967. Holotype: '*Boletus byssinus* Schrad. (Fungus nascens), Herb. Pers.' (L 0117094, studied). Epitype (designated here): Finland, Uusimaa, Tammisaari, 1987 Niemelä 4018 (L, isoeotype H).

Annual, resupinate, soft leathery, when dry hard, basidiocarps 30–60 $\times$ 10–30 mm, irregularly roundish, usually emerging solitarily. Sterile margin narrow, matt, hygrophanous especially in upper half of the basidiocarp. Pores 5–7 per mm, when fresh hygrophanous translucent or (after dry period) cream-coloured, when dry cream-coloured or with an apricot tint; orifices entire. Section: subiculum 0.1–0.5 mm, cream-coloured, tubes concolorous or darker. Dimitic, generative hyphae with clamps, skeletal rather uniform, CB(+), IKI–, 1.7–3.7 μm in diam., in subiculum with spaced and interwoven structure, basal layer almost monomitic; tramal hyphae interwoven, agglutinated; skeletal with variably visible lumen. crystal clusters sometimes present in between hyphae; hyphal tips at orifices often slightly inflated; no clear cystidioles or gloecystidia. Spores ellipsoid, thin-walled, CB–, IKI–, (3–)3.4–4.4(–5.1) $\times$ (2.2–)2.3–2.9 (–3.1) μm , ventral side convex or (rarely) flat, never concave.

SPECIMENS EXAMINED—Finland. Varsinais-Suomi: Tammisaari, *Corylus*, 5.IX.1971 Niemelä; see epitype. Turku, *Quercus*, 1937 Laurila 720, 721. Uusimaa: Helsinki, *Alnus*, 1993 Saarenoksa 24293. Sipoo, *Alnus*, 1987 Saarenoksa 11587. Etelä-Häme: Kuru, *Betula*,

2003 Miettinen 7919. Lammi, *Corylus*, 1997 Niemelä 6095; *Populus*, 2003 Miettinen 7488. Kittilän Lappi: Kittilä, *Betula*, Niemelä 6757. Russia. "Sibiria, Wasjuganje", *Betula*, 1934 Krawtzev W 115 (PRM 811661). Sweden. Uppland: Norra Warleda, *Corylus*, VIII.1970 Jahn. Kalmar, *Corylus*, 22.X.1995 Toresson.

The species is characterised by resupinate basidiocarps, large spores and agglutinated tramal hyphae. *Antrodiella pachycheiles* has similar spores, but it is pileate, its hyphal structure is different and skeletal swell and eventually dissolve in KOH. *Antrodiella subradula* (see below) is fairly similar but its spores are shorter and narrower and its tramal hyphae are separate, not agglutinated.

Donk (1967) proposed the name *Poria romellii* for a resupinate species that was featured by Romell (1926) and Eriksson (1949) as '*Poria byssina* (Schrad.) Fr.' In a thorough analysis Donk concluded that the name *P. byssina* must be typified elsewhere, and hence he gave a nomen novum, *Poria romellii*, for the taxon now included in *Antrodiella*. Donk emphasised that his species concept was based on texts and illustrations by Romell and Eriksson—and, in particular, the 'excellent' drawing by Eriksson (1949, Fig. 1). Accordingly, he designated the holotype (L 0117094) from the specimens that Romell and Eriksson had studied and identified in Persoon's herbarium.

We restudied the holotype; the specimen is a young basidiocarp, substerile, and partly mould-contaminated. Salient characters could be seen, however. There are 3–4 thin, resupinate, cream-coloured basidiocarps arising from the bark of (evidently) *Corylus avellana*. Pores are round, (5–)6–7 per mm. Only collapsed basidia with four sterigmata, and a few turgid spores (3.8–4.7×2.7–2.8 µm) were found. Hyphal system is dimitic, generative hyphae thin-walled and clamped, skeletal weakly cyanophilous and 2.2–3(–3.8) µm thick, no basal layer, no gloeocystidia. Trama is largely monomitic due to the young age of the basidiocarp; tramal tissue is dense and hyphae are subparallel. These characters match with the description and drawing by Eriksson (1949) and with the present concept of the species.

Since the type material is scanty and in a poor condition, its value as research material is inferior in a group where exact spore dimensions are the most important criteria for a species concept. In order to settle the identity of the species, we here select an **epitype** for *Poria romellii*, specimen Niemelä 4018 (L, H). This specimen is strikingly similar to the holotype, and in a good fertile condition. It was studied and sequenced by Johannesson et al. (2000) in their study of *Antrodiella*. Epitype's nuclear ribosomal RNA internal transcribed spacer (ITS) is deposited in GenBank (acc. no. AF126899).

Donk's concept of *Poria romellii* was mixed: we studied another specimen (L0194116), determined by Donk, collected in 1963 by him in the Netherlands from a fallen branch of *Quercus*. That specimen has larger pores (3–5 per mm) and much narrower spores, about 3.7–4.8×1.9–2.3 µm, and it seems to be conspecific with the newly (Bernicchia 2005) described *Antrodiella ichnusana*; see its notes.

Antrodiella serpula (P. Karst.) Spirin & Niemelä, **comb. nov.**

(MB500771)

Basionym: *Bjerkandera serpula* P. Karst., Meddel. Soc. F. Fl. Fennica 14:79, 1887. Holotype: Finland. 'Bjerkandera serpula Karst., Särkijärvi, ad *Pol. radiatum* et cort. *Alni*, m. Sept. 1886' (Herb. P.A. Karsten 4015, H, studied).

- = *Polyporus hoehnelii* Bres. ex Höhnelt, Sitzungsber. Kaiserl. Akad. Wiss. Wien, Math. Naturwiss. Kl. 121(1):344, 1912. Holotype: Austria. '*Polyporus höhnelii* Bres., typus!, ad *Carpinum*, leg. v. Höhnelt' (BPI US0211065, studied).
- = *Polyporus rufopodex* Romell, Svensk Bot. Tidskr. 6:641, 1912. Holotype: Sweden, Östergötaland, Simostorp, IX.1912 Haglund (Herb. Romell 13497, S; according to Ryvarden 1974, not studied).

Annual, pileate or effused-reflexed, leathery, when dry very hard. Caps at first nodulose, fully grown shelf-shaped or triangular in section, 10–60 mm wide, 5–20 mm thick, projecting 5–25 mm, surface matt or minutely hairy, when dry rough to touch, yellow, margin fairly sharp and yellow; resupinate area small and irregular in shape. Pores yellow or cream-coloured, 4–6(–7) per mm, orifices entire, serrate or dentate. Section: context cream-coloured, homogeneous, when dry hard, 2–8 mm thick; tubes concolorous or yellowish. Dimitic, generative hyphae with clamps, skeletal distinctly CB+, IKI–, in context interwoven, (2–)3–5.2(–6) μm in diam., in tube trama parallel, (2.8–)3–4.4 (–5.3) μm , especially in context and upper trama robust-looking, very thick-walled and with a distinct, wide lumen. Small, sandy or cubical crystals sometimes present on hyphae. Cystidioles with a conical apex; gloeocystidia evidently absent. Basidia with 4 sterigmata. Spores short cylindrical, thin-walled, CB–, IKI–, (3.3–)3.6–5(–5.7) $\times$ (1.6–)1.8–2.2(–2.5) μm , curved along their whole length.

SPECIMENS EXAMINED—**Austria** (type of *P. hoehnelii*). **Czech Rep.** Bohemia: Sázava, *Fagus*, 1991 Niemelä 5529. **Estonia**. Pärnumaa: Koonga, *Corylus*, 1996 Niemelä 6015. **Finland**. Uusimaa: Helsinki, *Alnus*, 1986 Saarenoksa 18686. Etelä-Häme: Lammi, *Corylus*, 1985 Niemelä 3278; 2000 Niemelä 6899. Tammela (type of *B. serpula*).

—All on dead *Inonotus radiatus*, except type of *P. hoehnelii* (not indicated).

This is the most robust of the *Antrodiella* species treated here. Under the microscope it stands out in having thick skeletal hyphae, which often ramify in the context and are strikingly parallel in tube trama, and which are more strongly cyanophilous than in the other species.

While studying the specimens of Karsten, one of us (W.S.) found that the type of *Bjerkandera serpula* in fact represents the present species. The specimen is small but fertile, and it is growing on remnants of *Inonotus radiatus*. A closer study on spores and other microscopy confirmed this result. Holotype was depicted in Karsten's *Icones* (Karsten 1891), but even though coloured this lithograph is not very illustrative.

This is one of the best-known species in the genus, belonging to its narrow-spored group (Fig. 2). The yellow basidiocarps usually arise from angiosperm wood decayed by *Inonotus radiatus*. Hyphal structure is more robust than in most species of the genus, but in the phylogram by Johannesson et al. (2000) its position is in the core of the genus, close to *A. pallescens* (the European '*A. semisupina*'). The type of *Polyporus hoehnelii* is sterile, but agrees with the current concept of the species, e.g. in having the same characteristic hyphal structure as the type of *A. serpula*.

Pilát (1936–1942) doubtfully linked *Bjerkandera serpula* to *Trametes hoehnelii* (Bres. ex Höhn.). Pilát in the Index of his book, but did not treat the matter in the text and so the reasons for his conclusion are not known. Lowe (1956) studied the type, but could not agree with Pilát's proposal and left the decision open.

Donk (1974) lists *Polyporus scaber* Velen. 1922 as a synonym of the species, but the name is an illegitimate homonym of *P. scaber* Bres. (Bresadola 1920).

Antrodiella subradula (Pilát) Niemelä & Miettinen, **comb. nov.**

(MB500773)

Basionym: *Coriolus subradula* Pilát, Bull. Soc. Mycol. France 51:366, 1936. Lectotype: 'Siberia, Distr. Tara, *Salix* sp., IX.1929 Ziling 233' (PRM 811662, studied). Selected as type by Donk (1974:370).

Annual, resupinate, when dry hard, basidiocarp ca. 6–15×5–10 mm, irregularly roundish. Sterile margin very narrow or absent. Pores (2–)3–5 per mm, cream-coloured, variably sized; orifices entire. Section: subiculum straw-coloured, tubes dark cream-coloured. Dimitic, generative hyphae with clamps, skeletal CB(+), IKI–, in subiculum (3–)3.7–4.6(–5.4) µm in diam. and in KOH swelling to up to 5.3–6 µm; in tube trama (2.2–)2.6–3.5 µm, tightly interwoven and agglutinated in upper trama and subparallel close to orifices. Crystals abundant in subiculum, mostly as small rhomboidal plates or prisms. No gloecystidia, cystidioles 9–10.9×4–4.5 µm, inconspicuous with nipple-like apex. Basidia with 4 sterigmata. Spores ellipsoid, thin-walled, CB–, IKI–, (3.2–)3.3–3.9(–4.1)×(2–)2.1–2.3(–2.4) µm, ventral side convex or (rarely) flat, never concave.

SPECIMENS EXAMINED—**Russia** (see type).

Pilát (1936) returned to the form that he originally described as *Coriolus pallescens* f. *resupinata* (Pilát 1932) by raising it to species rank as *Coriolus subradula*. Two Siberian specimens were listed, one from *Betula* (Krawtzev W 115) and another from *Salix* (Ziling 233). If the specimen from *Betula* had been selected as type, this would be an older name for *Poria romellii*. However, Donk (1974:370) lectotypified both *Coriolus pallescens* f. *resupinata* and *Coriolus subradula* according to the specimen from *Salix* (Ziling 233). Pilát himself had written 'Typus!' on the label of the collection from *Betula* (W 115), but that was not published, and so Kotlaba & Pouzar (1989) were misled when they accepted this as the type (they later corrected their interpretation: F. Kotlaba & Z. Pouzar 1992, in herb.). This taxon is without doubt an *Antrodiella*, but spore dimensions do not match with any species that we know (Tab. 1, Fig. 2). Therefore we accept *A. subradula* as a good species in *Antrodiella*. The lectotype specimen was illustrated in Pilát (1936, Pl. 7:3, magnification ×8, not indicated in the paper).

The lectotype specimen is a small but very fertile, resupinate basidiocarp, resembling *Antrodiella romellii* but with larger pores (5–7 per mm in *A. romellii*), and having shorter and narrower spores. *Antrodiella faginea* is also fairly similar, but its spores and pores are smaller, and skeletal hyphae appear thicker. More material is needed.

Antrodiella thompsonii Vampola & Pouzar

Czech Mycology 49: 27, 1996. Holotype: *Poria*, Canada, Ontario, Lake Temagami, on *Populus grandidentata*, 26.VIII.1930 G.E. Thompson (PRM 810111, ex herb. L.O. Overholts).

Annual, resupinate, woody hard, 1–2 mm thick. Sterile margin almost nonexistent, i.e. pores extend to the edge; pore surface tan with darker brown flecks, pores angular, regular, 7–9 per mm. Section: subiculum thin but very distinct, 0.1–0.2 mm thick, creamy white, with a dense and homogeneous structure, tubes brownish and oily-looking, colour contrast strong between subiculum and tubes. Dimitic; generative hyphae with clamp connections, skeletal weakly but clearly cyanophilous, with a clearly

Table 2. Key characters of *Antrodiella* species treated in this paper.

Group	Species	Ecology	Macroscopy	Pore size (per mm)	Hyphal structure	Spores (L×W in µm)
Small ellipsoid spores W ≤ 2.1 µm L < 4 µm Q ≤ 2	<i>americana</i>	angiosperm wood decayed by <i>Pseudochaete tabacina</i>	resupinate, yellow, pores soon splitting	large (2-4)	CB(+) to CB+, clear gloeocystidia abundant (15-60×4-8 µm), skeletal rather narrow, mostly 2.2-3.1 µm in subiculum, with a clear lumen	narrow ellipsoid to cylindrical, uniguttulate (3.72×2.05)
	<i>ellipsospora</i>	type on brown-rotted <i>Pinus sibirica</i>	half-resupinate, white to cream-coloured	small to very small (7-9)	weak CB(+), skeletal rather robust in subiculum (3-3.5 µm), lumen indistinct	narrow ellipsoid (3.59×1.95)
	<i>faginea</i>	various deciduous trees, often associated with <i>Hymenochaetac.</i>	half-resupinate, pores white to cream- coloured	small (6-8)	CB(+), skeletal robust in subiculum (2.7-4.2 µm), lumen indistinct, gloeocystidia sometimes present	ellipsoid, not curved (3.20×1.97)
	<i>pallasii</i>	associated with <i>Trichaptum abietinum</i> , on gymnosperms	half-resupinate, yellowish, pore mouths often lacerate, splitting	small (6-8)	CB- to weak CB(+), subicular skeletal rather narrow, mostly ≤ 3 µm, tramal skeletal with large lumen	ellipsoid, belly often straight, uniguttulate (3.23×1.93)
	<i>pallesens</i>	associated with <i>Fomes fomentarius</i>	half-resupinate, pores white to cream- coloured	small (6-8)	CB(+), skeletal robust in subiculum (3-4.6 µm), lumen indistinct	straight/slightly curved belly (3.47×1.84)
	<i>semisupina</i>	type on <i>Quercus</i>	half-resupinate, orange tints	small (6-8)	CB-, hyphae flexuose, (2-)3-4.2(-5) µm	egg-shaped (3.00×2.09)
	<i>thompsonii</i>	type on <i>Populus</i>	resupinate, pores resinous	very small (7-9)	CB- to CB(+), tramal hyphae strongly agglutinated, skeletal 2.5-4 µm, gloeocystidia present	broad cylindrical to ellipsoid (3.15×1.79)

Slender spores $Q > 2$ $W \leq 2 \mu\text{m}$	<i>ichnusana</i>	on branches of <i>Alnus</i>	resupinate, white to straw-coloured, hygrophanous	relatively large (4–5)	CB(+), skeletal narrow, with a clear lumen, 2–3.2 μm	rather straight (4.55×1.95)
	<i>leucoxantha</i>	various deciduous trees	half-resupinate, whitish	medium (5–6)	CB(+), subcircular skeletal rather large (2.6–4 μm), lumen distinct, gleocystidia occasional	always curved (3.89×1.71)
	<i>onychoides</i>	various deciduous trees	half-resupinate, whitish	medium to small (5–8)	CB(+), no clamps, skeletal 3.1–4 μm in subiculum, with a distinct lumen	always curved (3.86×1.75)
Wide spores $W > 2 \mu\text{m}$	<i>serpula</i>	associated with <i>Inonotus radiatus</i>	pileate to half-resupinate, yellowish when old	medium (4–6)	CB+, skeletal very robust, commonly > 5 μm in subiculum, lumen distinct	always curved (4.12×1.95)
	<i>canadensis</i>	on gymnosperms	pileate, white, greyish upper surface when dried	medium (5–6)	CB-, monomitic or almost so, hyphae thin- to thick-walled, 2.2–5.4 μm , subcircular hyphae with finger-like, refractive branches	broad ellipsoid to subglobose, uniguttulate (3.43×2.64)
	<i>citrinella</i>	associated with <i>Fomitopsis pinicola</i> , usually gymnosperms	half-resupinate, yellow when fresh, colour fading upon drying	relatively large (4–5)	CB(+), skeletal with a clear lumen, rather narrow, 2.3–3.7 μm	broad ellipsoid to subglobose (3.14×2.31)
	<i>pachycheiles</i>	type on <i>Acer</i> , also <i>Betula</i>	half-resupinate, straw-coloured	small (7–8)	CB(+), skeletal wide, 3.6–4.6 μm in subiculum, swelling & dissolving in KOH, thin-walled cystidia	broad ellipsoid (3.67×2.45)
	<i>parasitica</i>	gymnosperms decayed by <i>Trichaptium abietinum</i>	resupinate, straw-coloured, orifices entire to lacerate	medium (5–6)	CB(+), tramal tissue dense, robust hymenium staining strongly in CB & IKI, basidia robust, skeletal 2.5–3.3 μm	broad ellipsoid, often uniguttulate (3.63×2.50)
	<i>romellii</i>	deciduous wood, often fallen branches	resupinate, cream-coloured or with apricot tint	medium to small (5–7)	CB(+), tramal hyphae agglutinated, skeletal 1.8–3.5, basidia robust	broad ellipsoid (3.84×2.55)
	<i>subradula</i>	type on <i>Salix</i>	resupinate, white	relatively large (3–5)	CB(+), skeletal rather narrow, 2.5–3.5 μm , not agglutinated	relatively narrow ellipsoid (3.49×2.18)

visible lumen, IKI-, KOH-. Subiculum with 5–20 µm thick basal layer of subparallel and glued-together generative hyphae; subiculum proper homogeneous with very tightly packed, interwoven, but separate hyphae, skeletal (1.8–)2.3–3.8(–4.2) µm. Tube trama with tightly interwoven hyphae, glued throughout into inseparable, glassy structure, skeletal 2–3.2 µm in diam. Cystidioles with a conical apex, hymenium with few and poorly differentiated gloeocystidia, 10–12×4–6.5 µm, best seen in IKI. Basidia with 4 sterigmata. Spores ellipsoid or short cylindrical, thin- and smooth-walled, IKI-, CB-, (2.8–)2.9–3.6(–3.8)×(1.6–)1.7–2 µm, ventral side flat, seldom slightly convex, almost never concave.

SPECIMENS EXAMINED—Canada (see type).

This seems to be a well-defined species, to us known from the type locality only. Externally it is characterised by resupinate habit, very small pores, and, in particular, the colour contrast between almost white subiculum and oily brownish tubes. Microscopic structure resembles that of *A. romellii* by its tightly glued hyphae of tube trama; this agglutination is even stronger than in *A. romellii*. Skeletal hyphae are fairly narrow. In the hymenium gloeocystidia can be seen, but they are not prominent and do not suffice for identification. The short cylindrical spores come closest to those of *A. pallescens*, but the other characters disagree.

Trametes subscutellata Murrill

Mycologia 2:191, 1910. Lectotype (designated here): *Trametes subscutellata*. Jamaica, Moneague to Union Hill, 17–18.I.1909 W.A. Murrill 1129 (NY, studied). Lowe (in herb.) and Ryvar den (1985) called this as 'type' and in the convolute there is a note 'part of type' by Murrill; hence this must be considered to be the lectotype.

Ryvar den (1985) considered this to be a synonym of *Antrodiella semisupina*. The type specimen is from Jamaica, i.e. subtropical Caribbean. The specimen is half-resupinate, button-shaped, whitish to straw-coloured, with small pores 8–9 per mm. Hyphal system is dimitic with branching skeletal (3.2–5 µm) that stain relatively strongly in CB for an *Antrodiella* species, and swell a little (up to 8 µm) but remain distinct in KOH. We could not find any hymenium in good condition, and only a few spores were found, broadly ellipsoid, within the range of 2.7–4.3×2–2.8 µm. The identity of this species should be solved based on collections from the Caribbean. We do not think it is conspecific with *A. semisupina*, whose skeletal are flexuous, CB-, or with *A. pallescens*, which has narrower spores and a more northerly distribution.

Discussion

Identifying species of *Antrodiella* is often difficult, since differences between the species are small. In Table 2 we summarise the main characters of all the species treated here. The species have been sorted into three groups based on their spore characters (see also Fig. 2).

Gloeocystidia have been used to delimit species (for instance *Postia leucomallella* (Murrill) Jülich) and even genera (*Gloeocystidiellum*) in *Aphylophorales*. The exact meaning of the term varies greatly in the literature, sometimes used only for plasma-rich special cells that arise from subhymenium (like in *Antrodiella*), sometimes also for

the terminal ends of gloeoplerous tramal hyphae that penetrate into the hymenium. Cléménçon (2004) summarised the different types of these cells and their exact terms.

Here we use the term gloeocystidium for those thin-walled hymenial cystidia that stain more yellow or refract more strongly in IKI than other hymenial cells, and become deep blue-tinted in Cotton Blue. They are a good and constant character in some species (for instance, *Antrodiella americana*), but our work shows that they are unreliable in several other species of the genus. *A. faginea*, whose description was largely based on the presence of gloeocystidia, does not seem to bear them commonly. A similar case is *A. leucoxantha*, in which gloeocystidia are found only in some specimens. Of the studied tens of collections of *A. pallescens*, gloeocystidia were found in just one, otherwise typical specimen. One of the key characters of *A. parasitica* is said to be the presence of gloeocystidia (Vampola 1991). However, we could not find any clear cystidia in the studied specimens, rather just yellow-tinted hymenial cells.

Indeed, in all the *Antrodiella* species where gloeocystidia have been reported—except *A. americana*—they are weakly differentiated, rare, and often difficult to verify. They are commonly associated with senescent hymenium at tube bottoms. Difference between poorly differentiated gloeocystidia and thin-walled hymenial cystidia that do not stain in IKI (*A. pachycheiles*) is vague. We stick to the term gloeocystidia, since it has been traditionally used in this context. Other types of abnormal sterile cells are also commonly present in senescent basidiocarps, such as vesicular cells and projecting hyphoid elements. In our mind, taxonomic conclusions in *Antrodiella* should not be based on presence or absence of cystidia alone, although they may be a useful character among the others.

Acknowledgements

Reima Saarenoksa (Helsinki) gave his extensive *Antrodiella* collections at our disposal, and his notes on *A. ichnusana* were invaluable in outlining the ecology of this recently found species. Heikki Kotiranta (Helsinki) forwarded some Siberian collections to us. Pertti Renvall (Kuopio) and Annarosa Bernicchia (Bologna) gave us materials, e.g. of *A. ichnusana*. Tuuli Timonen and Pirkko Harju (Helsinki) identified some host tree species from wood attached to fungal specimens. Leif Ryvarden (Oslo) and Joost Stalpers (Utrecht) reviewed the manuscript. The museums listed in Materials and methods are thanked for loans of type and other materials. We thank the Finnish Ministry of Environment and Emil Aaltonen Foundation for research grants.

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New records of *Pluteus* (Pluteaceae, Agaricales) from Brazil

FELIPE WARTCHOW

fwartchow@yahoo.com.br

Universidade Federal de Pernambuco, Departamento de Micologia, CCB
Av. Prof. Nelson Chaves, s/nº, CEP: 50670-901, Recife, PE, BRAZIL

VAGNER GULARTE CORTEZ & GILBERTO COELHO

cortezvg@yahoo.com.br, coelhoqb@yahoo.com.br

Universidade Federal do Rio Grande do Sul

Programa de Pós-graduação em Botânica

Av. Bento Gonçalves, 9500, CEP: 91501-970 Porto Alegre, RS, BRAZIL

Abstract—The occurrence of some previously unreported species of *Pluteus* from Brazil (*P. aquosus*, *P. nigrolineatus*, and *P. globiger*) is reported. Collections of *P. albobipitatus* and *P. beniensis* are also described from Rio Grande do Sul State. All taxa are illustrated and discussed.

Key words—Basidiomycota, Agaricomycetidae, *Celluloderma*, *Hispiderma*

Introduction

The knowledge of the genus *Pluteus* Fr. in Brazil started with Rick (1907, 1919, 1930, 1938) from the Rio Grande do Sul State. In his posthumous work (Rick 1961), Rick reported 18 species from this State, some described as new species: *P. cristatulus* Rick, *P. fibrillosus* Rick, *P. leptonia* Rick, *P. sensitivus* Rick, *P. straminellus* Rick, and *P. velatus* Rick. Singer (1953, 1959) studied several Rick's collections and considered most of them either dubious (due to the lack of preserved material) or synonyms of already described species in *Pluteus* and other genera (e.g. *Entoloma* (Fr.) P. Kumm.).

Singer (1956, 1959, 1973, 1989) described several new species collected in different Brazilian states, especially the Rio Grande do Sul, Amazonas, Rio de Janeiro, and Pará. Recent surveys on *Pluteus* from Brazil are those of Stijve & de Meijer (1993) for the state of Paraná (south Brazil) and Pegler (1997) for the state of São Paulo (southeastern Brazil). Putzke (1994) reported 23 *Pluteus* taxa in his checklist of Brazilian agarics. More recently, Wartchow et al. (2004) cited *P. thomsonii* (Berk. & Broome) Dennis for Brazil, and Rother et al. (2006) listed *Pluteus* species from Rio Grande do Sul State.

Materials and Methods

Microscopic analysis comprised 25 measurements each of basidiospores, basidia, cystidia and hyphae observed in 5% KOH preparations. The microstructures were drawn using a camera lucida. The specimens are deposited in the herbaria of the Biology Department of the Universidade Federal de Santa Maria (SMDB) and Department of Botany of the Universidade Federal do Rio Grande do Sul (ICN). Generic and infra-generic concepts follow Singer (1986).

Taxonomy

1. *Pluteus allostipitatus* (Dennis) Singer, Lloydia 21: 240, 1959.

FIGS. 1-5

= *P. spilopus* var. *allostipitatus* Dennis, Bull. Soc. Mycol. Fr. 69: 195, 1953.

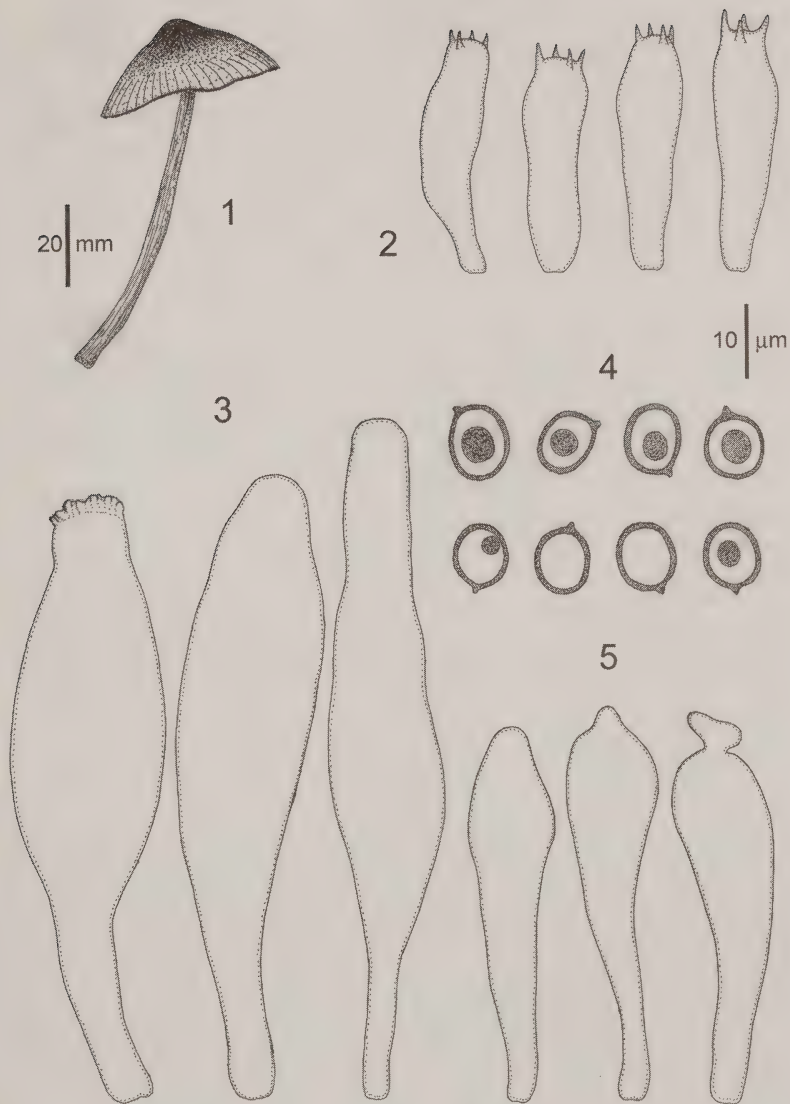
Pileus 50–55 mm diam., campanulate to plane, with a broad and low umbo, dark-brown in color, surface subviscid with a sulcate-striate margin. **Lamellae** free, abundant and close, ventricose, cream-colored then pink in maturity. **Stipe** 53–73 × 4–6 mm, central, cylindrical, cream to grayish colored, with longitudinal dark brown fibrils. **Context** fleshy, white. **Spore print** pink.

Basidiospores (6–) 6.4–9 (–9.6) × (4.8–) 5.6–7.6 µm, in average 7.7 × 6.5 µm, Q = (1.05–) 1.10–1.25 (–1.33), subglobose to broad ellipsoid, smooth, with a thickened wall, stramineous. **Basidia** 28–38 × 7.2–11.2 µm, clavate, bearing four sterigmata. **Pleurocystidia** 56.7–97.6 (–113) × 12–24 µm, fusoid or lageniform, with an apical constriction and the apex sometimes forming a broad capitellum, with a slightly thickened wall, hyaline. **Cheilocystidia** 35.2–71.2 × 8–18.4 µm, clavate, sometimes with a short mucro or a narrower neck on the apex, thin-walled, hyaline. **Pileipellis** is a repent cutis, composed by terminal hyphae 13.6–20 µm diam., with rounded apex, and containing a brownish pigment. **Clamp connections** absent.

Habitat: solitary, on decayed wood in a subtropical rain forest.

Studied material: BRAZIL. Rio Grande do Sul State: Santa Maria, Morro do Elefante, 22.V.2002, F. Wartchow & J.C. Budke, 22.V.2002, Wartchow 039 (SMDB 9.712).

Remarks: This species belongs to stirps *Spilopus* of section *Hispidoderma* Fayod and was originally described as a variety of *Pluteus spilopus* by Dennis (1953). However, this paleotropical species differs in having black squamules on the stipe surface and clavate-pedicellate cheilocystidia (Pegler 1986). Singer (1973) described *P. allostipitatus* var. *poliobasis* Singer from the State of Veracruz (Mexico) based on the grayish color at the bottom of the stipe instead of a white color. Later, Rodríguez & Guzmán-Dávalos (2000) found the same variety in the State of Jalisco and described basidiospores globose to subglobose (6–8 × 5.6–8 µm); they also revised the type of Singer's variety and found basidiospores 4.8–7.2 × 4.4–6 µm. Courtecuisse (1991) recorded *P. allostipitatus* with smaller basidiome (12 mm diam.) and basidiospores (5.5–6.5 × 4.5–5.2 µm). In our collection the pleurocystidia have the same shape as those materials reported by Dennis (1953), Singer (1959), Pegler (1983), and Courtecuisse (1991), but the cheilocystidia sometimes presents a short mucro or a narrower neck on the apex. A close species is



Figs. 1-5. *Pluteus albobstipitatus*.

1. Basidiome. 2. Basidia. 3. Pleurocystidia. 4. Basidiospores. 5. Cheilocystidia.

P. melanopotamicus Singer, but it differs mainly by the shape of the pleurocystidia and its thick wall, but not truly metuloidal (Singer 1989).

Stijve & de Meijer (1993) studied some *Pluteus* species suspected or reported to be psychotropic and did not found psychoactive compounds in *P. albobostipitatus*. This species can be considered common in tropical and subtropical America, being reported from several countries: Trinidad (Dennis 1953), Argentina (Singer 1956, 1959; Horak 1964), Martinique (Pegler 1983), Mexico (Singer 1973; Rodríguez & Guzmán-Dávalos 2000), Galapagos Islands (Reid et al. 1981), and the French Guyana (Courtecuisse 1991). A Central African report by Horak (1978) is also known. In Brazil, *P. albobostipitatus* is known from the States of Paraná (Stijve & de Meijer 1993), São Paulo (Pegler 1997), and recently it was cited from Rio Grande do Sul by Rother et al. (2006).

2. *Pluteus aquosus* Singer, Trans. Br. Mycol. Soc. 39: 148, 1956.

FIGS. 6-11

Pileus 12–20 mm diam., convex to plane, somewhat depressed on center, surface dry, with striate to slightly plicate-sulcate margin, whitish at disc to slightly pinkish toward the margin. **Lamellae** free, rather close, pinkish. **Stipe** 17–25 × 1–2 mm, central, cylindrical, hollow, white, longitudinally striate, presenting a whitish basal mycelium. **Context** thin, whitish. **Spore print** pinkish.

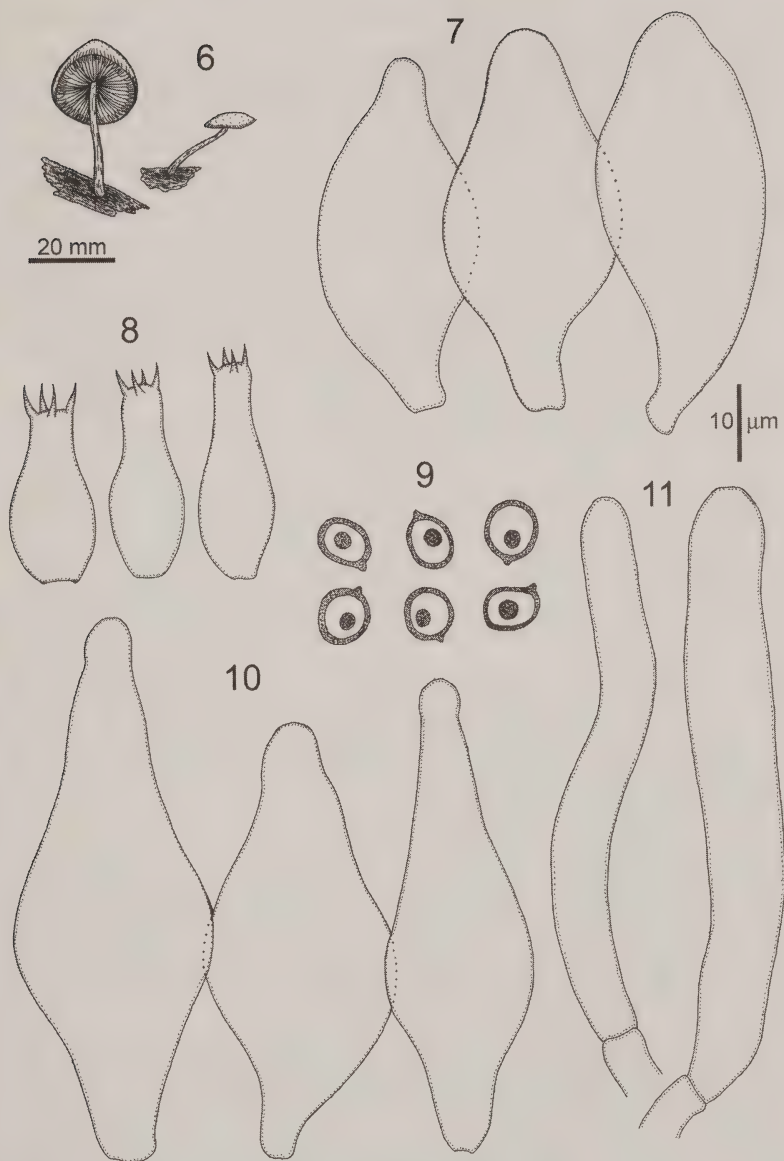
Basidiospores 5–7.5 × 4.5–6.5 µm, in average 6.2 × 5.6 µm, Q= (1–) 1.06–1.23 (–1.31), mainly subglobose, but also short-ellipsoid or globose, smooth, thin-walled, stramineous. **Basidia** 19–29 × 7.5–12.5 µm, bearing four (rarely two) sterigmata, ventricose, thin-walled. **Pleurocystidia** 37–73 × 15–29 µm, fusoid to fusoid-ventricose, with a rounded apex, thin-walled, hyaline. **Cheilocystidia** 39–59 × 17–30.5 µm, fusoid to ventricose, thin-walled, hyaline. **Pileipellis** consisting of hyphoid dermatocystidia, 63.5–164 × 9–30.5 µm, with rounded to slightly obtuse apices, hyaline. **Clamp connections** absent.

Habitat: solitary on decayed wood in subtropical rain forest.

Studied material: BRAZIL. Rio Grande do Sul State: Santa Maria, Morro do Elefante, 24.XII.2001, V.G. Cortez 053/01 (SMDB 9.263).

Remarks: *Pluteus semibulbosus* (Lasch) Quél., *P. haywardii* Singer, *P. niveus* Murrill, and *P. myceniformis* Murrill, belong to stirps *Semibulbosus* of section *Hispidoderma* together with *P. aquosus*. A very similar species is *P. haywardii*, known from the State of São Paulo (Pegler 1997), but this species is separated from *P. aquosus* by the presence of black fibrils on both pileus and stipe, and by the brownish cystidioid hyphae in the pileipellis (Singer 1959). Another similar taxon is *P. albidus* Pegler from Africa (Pegler 1977), differing from *P. aquosus* mainly by the broader basidiospores (6–8 × 5.5–7.5 µm). Our collection agrees with the original description by Singer (1956, 1959) except by the smaller pileus, but the microscopic data of the pileipellis elements and basidiospores support our identification.

Pluteus aquosus was originally described by Singer (1956) from the province of Tucumán, Argentina, and since then was not reported anywhere. The present report is probably the second world record of this species and the first from Brazil.



Figs. 6-11. *Pluteus aquosus*.

6. Basidiomes. 7. Cheilocystidia. 8. Basidia. 9. Basidiospores.
10. Pleurocystidia. 11. Pileipellis elements.

3. *Pluteus beniensis* Singer, Lloydia 21: 285, 1959.

FIGS. 12-17

Pileus 19 mm, plane-convex, brown, rugose when fresh at the center with a short striate margin. **Lamellae** free, close, cream then pinkish and with a darker edge when fresh, but not evident after dried. **Stipe** 26 × 1 mm, central, cylindrical, cream, with a grayish base. **Context** very thin, whitish. **Spore print** not observed.

Basidiospores 5–7.2 × 4.4–6.4 µm, in average 5.7 × 5.2 µm, Q= (1–) 1.06–1.16, globose to subglobose, smooth, with a slightly thickened wall, stramineous. **Basidia** 19–27.5 × 6.8–9.2 µm, fusoid-clavate, bearing four sterigmata. **Pleurocystidia** 52–67.6 (–79.2) × 15.2–25 µm, mainly narrowly fusoid, some subclavate, thin-walled, hyaline. **Cheilocystidia** 24–42 × 9.6–18.4 (–24) µm, inflate-clavate, clavate to rarely fusoid, thin-walled, with brownish content. **Pileipellis** an epithelium, terminal elements 28.4–44.8 × 7.5–31.5 µm, pyriform, thin-walled, with dark brown dissolved content. **Clamp connections** absent.

Habitat: solitary, on decayed wood in a subtropical rain forest.

Studied material: BRAZIL. Rio Grande do Sul State: Santa Maria, Morro do Elefante, 02.XI.2002, D.L. Bordinon & J.C. Budke (SMDB 9.711).

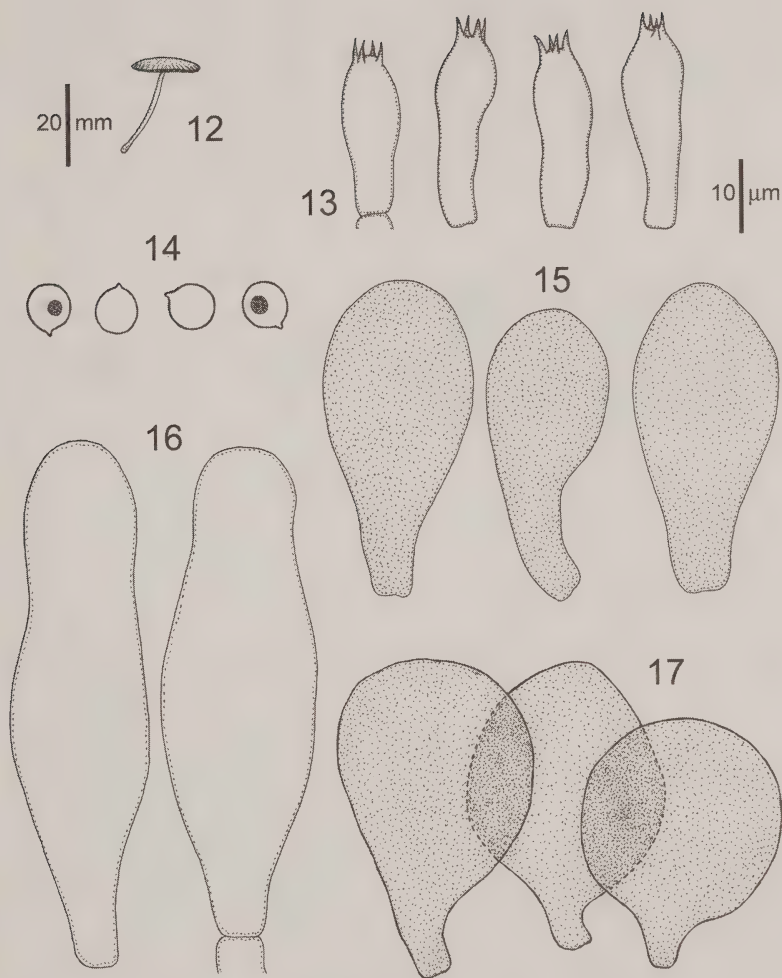
Remarks: This species is placed in stirps *Luctuosus*, belonging to subsection *Eucellulodermini* Singer of section *Celluloderma* Fayod by the absence of yellow, red or orange tones, cheilocystidia with brownish content, and pileipellis as a true epithelium without dermatocystidia (Singer 1986). *Pluteus luctuosus* Boud., known from Argentina, is a close species but has slightly larger (6–8 × 5.3–7.2 µm) and rounder basidiospores, the gill edge more strongly colored in dry specimens and a dark floccose surface of the stipe (Singer 1959, 1961). The other two species of this subsection, *P. riograndensis* Singer and *P. rimosoaffinis* Singer, have condensed brownish content in the pileipellis elements. Described originally by Singer (1959) from Bolivia, this species was also reported from Paraná State, as suspect of containing psychoactive substances (Stijve & de Meijer 1993). *Pluteus beniensis* was recently cited for the first time from Rio Grande do Sul State by Rother et al. (2006).

4. *Pluteus globiger* Singer in Singer & Digilio, Lilloa 25: 266, 1952.

FIGS. 18-23

Pileus 7 mm diam., convex to plane, umbonate, surface humid, hygrophanous, slightly rugulose and brownish-orange on the umbo, to yellowish toward the margin, which is also striate. **Lamellae** free, close, ventricose, pinkish. **Stipe** 15 × 1 mm, central, cylindrical, with a tapered base, humid, with a slightly cartilaginous consistency, yellowish. **Context** very thin, pale yellowish. **Spore print** not observed.

Basidiospores 5.5–6.5 µm, globose, smooth, with a thickened wall, stramineous, with a distinct apiculus. **Basidia** (20–) 22–25 (–28) × (7–) 8–9 µm, clavate to ventricose, bearing four (rarely two) sterigmata. **Pleurocystidia** 37–55 × 17–22 µm, clavate-vesiculose to ampullaceous and broad ventricose, with a rounded apex, very scattered, thin-walled, hyaline. **Cheilocystidia** 40–63 × (10–) 15–23 (–29) µm, very similar to the pleurocystidia in shape, hyaline. **Pileipellis** an epithelium, composed by 1–2 layers of subglobose to sphaeropedunculate elements, (17–) 22–30 µm wide, thin-walled, with a brownish pigment completely dissolved. **Clamp connections** absent.

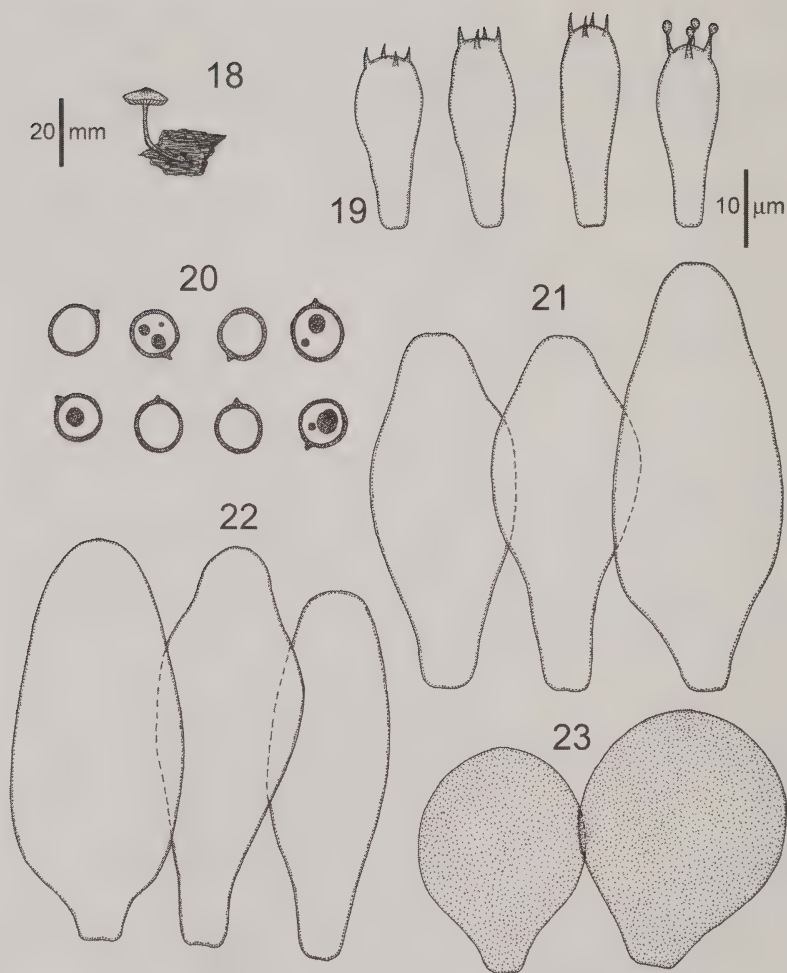


Figs. 12-17. *Pluteus beniensis*.

12. Basidiome. 13. Basidia. 14. Basidiospores. 15. Cheilocystidia.
16. Pleurocystidia. 17. Pileipellis elements.

Habitat: solitary, on decayed wood in a subtropical rain forest.

Studied material: BRAZIL. Rio Grande do Sul State: Porto Alegre, Campus da Universidade Federal do Rio Grande do Sul, 30.IX.2004, V.G. Cortez 050/04 (ICN 139.025).



Figs. 18-23. *Pluteus globiger*.

18. Basidiome. 19. Basidia. 20. Basidiospores. 21. Pleurocystidia.

22. Cheilocystidia. 23. Pileipellis elements.

Remarks: *Pluteus globiger* is another poorly known species described by Singer from Argentina (Singer & Digilio 1952). The author placed this species in stirps *Globiger*, subsection *Eucellulodermini* of section *Celluloderma* (Singer 1959). Taxonomically, *P. globiger* is defined by the brightly yellow pileus, the brownish cells of the pileipellis, and by the globose basidiospores (Singer 1959). A similar species included by Singer in this group is *P. xanthopus* Singer (1959), which is distinguished by the pileus color

(grayish-brown to olive-gray) and by the hyaline cells of the pileipellis. Singer (1959) also recognized several forms of *P. globiger*, based on variations of the pileus color and substrate (conifer or dicotyledonous wood), but did not proposed an infra-specific classification. He concluded that those specimens growing on dicotyledonous wood had a brighter colored pileus, as we observed on our material.

Pluteus globiger is a species with a subtropical to tropical distribution along the Americas, known from Mexico (Rodríguez et al. 1997), Venezuela (Dennis 1970), Argentina, Bolivia (Singer 1959), and now from Brazil.

5. *Pluteus nigrolineatus* Murrill, Mem. Torr. Bot. Club 66: 30. 1939.

FIGS. 24-28

Pileus 30 mm, campanulate, depressed at the disc, blackish-gray with greenish tints, surface subviscid and somewhat fibrillose. **Lamellae** free, close, ventricose, white then pinkish. **Stipe** 58 × 4 mm, central, cylindrical with a slightly expanded base, white, with greenish tints at the base. **Context** very thin, whitish. **Spore print** pink.

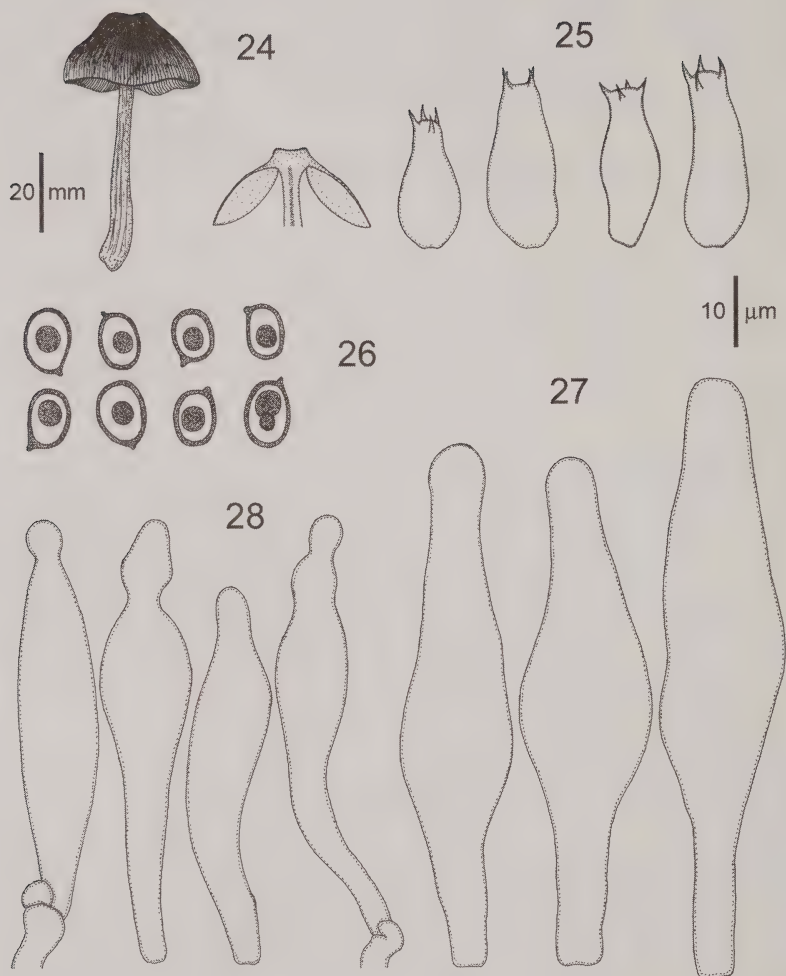
Basidiospores 5.6–8 × 4.8–5.6 µm, in average 6.9 × 5.2 µm, Q= (1.14–) 1.16–1.43 (–1.5), broadly ellipsoid, smooth, with slightly thickened wall, stramineous. **Basidia** 14.5–24.8 × 10.4–17.4 µm, ventricose, bearing four basidiospores. **Pleurocystidia** 45.6–76.8 × 10.4–17.6 µm, fusoid to lageniform, sometimes with a broad neck, projecting a subcapitellum or more frequently with a broad rounded apex, thin-walled, hyaline. **Cheilocystidia** 33.5–64 × 7.2–14.4 µm, fusoid-mucronate, often short mucronate or with a conspicuous neck, sometimes with a true capitellum, thin-walled, hyaline. **Pileipellis** with ascending hyphae, 75–90 × 7.2–12.5 µm, cylindrical with a rounded to sometimes acute apex, grayish-brown pigment, clamped. **Clamp connections** present, mainly on the base of the cheilocystidia and pileipellis hyphae.

Habitat: solitary, on decayed wood in subtropical rain forest.

Studied material: BRAZIL. Rio Grande do Sul State: Santa Maria, Boca do Monte Passo do Tigre, 16.II.2003, V.G. Cortez 001/03 (SMDB 9.710).

Remarks: *Pluteus nigrolineatus*, because the presence of elongated elements on pileipellis and thin-walled pleurocystidia, belongs to the rare group of clamped species of stirps *Nigrolineatus*, section *Hispiderma* (Singer 1986). This species is easily separated macroscopically from the other species of the group by the greenish base of the stipe. Homola (1972) reported from North America *P. cyanopus* Quél., another species with greenish tints in the stipe base, but the vesiculose to ellipsoid elements of the pileipellis and the absence of clamp connections, place this taxon in section *Celluloderma*.

According to Singer (1986), the other three species belonging to this stirps are: *P. brunneisucus* Pegler, from Africa, with abundant dark fibrils covering the stipe surface (Pegler 1966); *P. umbrinidiscus* Murrill, and *P. avellaneus* Murrill, which according to the type studies by Singer (1956) are synonyms, although Smith & Stuntz (1958) did not found clamp connections in the type of *P. avellaneus*. Banerjee & Sundberg (1993) analyzed both type specimens and concluded that *P. avellaneus* is in unsatisfactory conditions, and *P. umbrinidiscus* belongs to section *Celluloderma*.



Figs. 24-28. *Pluteus nigrolineatus*.

24. Basidiome and section. 25. Basidia. 26. Basidiospores.
27. Pleurocystidia. 28. Cheilocystidia.

Pluteus nigrolineatus is an American species, maybe common but probably overlooked, occurring from the United States and Mexico to Argentina and Chile (Singer 1961, 1969; Rodríguez & Guzmán-Dávalos 1997). The present report is the first one for the species from Brazil.

Acknowledgements

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**New species of marasmioid genera (Basidiomycetes,
Tricholomataceae) from tropical Africa - 6.
Marasmius cremeopileatus, a new species from Zimbabwe**

VLADIMÍR ANTONÍN¹ & CATHY SHARP²

¹vantonin@mzm.cz

Moravian Museum, Dept. of Botany, Zelný trh 6
CZ-659 37 Brno, Czech Republic

²mycofreedom@zol.co.zw

P.O. Box 55, Kariba, Zimbabwe

Abstract—A new tropical African *Marasmius* species, *M. cremeopileatus*, collected from two localities in Zimbabwe is described. It belongs in sect. *Sicci*, ser. *Haematocephali*.

Key words—*Agaricales*, new taxa, taxonomy

This paper is a continuation of a series with new taxa of the genera *Gloiocephala*, *Marasmius*, and *Setulipes* in tropical Africa. The complete study of these genera will be published in a new series of monographs “Flora Fungorum Africae Tropicalis” edited by the National Botanical Garden in Meise (Brussels, Belgium) in 2006.

Marasmius cremeopileatus Antonín & C. Sharp sp. nov.

(Figs. 1–4)

MB510042

Pileus 14–24 mm lato, convexo vel plano, cremeo. *Lamellis* distantibus, pallide luteis vel cremeo-brunneis. *Stipite* usque 35 mm longo, apicem pallide cremeo, ad basim sienna-brunneo. *Basidiosporis* (8,7–)9,0–11,5 x 3,5–4,2(–4,7) μ m, fusiformibus, sublacrinoideis, hyalinis, inamyloideis. *Cheilocystidiis* e cellulis similibus cellulis typo *Marasmii sicci*, 14–22 x 5,0–9,0(–11) μ m, clavatis vel subcylindraceutis. *Pleurocystidiis* 32–59 x 8,0–17 μ m, fusiformibus, subutri-formibus, subclavatis, tenuitunicatis. *Pileipellis* hymeniformis, e cellulis similibus cellulis hymenidermatis *Marasmii sicci*, 11–20 x 7,0–12 μ m, clavatis vel subcylindraceutis, tenuitunicatis, apicem subcrassitunicatis. *Caulocystidiis* absentibus. *Hyphis* fibulatis, in stipite et medulla dextrinoideis. Ad folia putrida.

HOLOTYPE: Zimbabwe, Bromley, Liemba Farm 1831 A2, 3. II. 1999 leg. C. Sharp 1321/99 (holotypus in herbario BRNM 699715 preservatur).

Pileus 14–24 mm broad, convex at first, then applanate, irregular, smooth or minutely rugulose, with smooth, entire margin, matt or finely tomentose, pale or cream coloured. *Lamellae* distant, L = 23–25, l = 2–3, $\pm$ free, pale yellowish or buff-cream coloured, with concolorous edge. *Stipe* up to 35 mm long, very slender, cylindrical or slightly tapering

towards base, tough, elastic, longitudinally finely fibrillose, non-insititious (with basal mycelium), cream or buff coloured at apex, through golden or fulvous to sienna brown towards base. Context membranaceous. Basal mycelium buff or cream coloured, and covering stipe base. Spore print white.

Basidiospores (8.7–)9.0–11.5 x 3.5–4.2(–4.7) μm , $E = 2.1\text{--}3.1$, $Q = 2.6\text{--}2.7$, fusoid, sublacriform, rarely septate, thin-walled, smooth, hyaline. Basidia 18–28 x 7.0–8.0 μm , 4-spored, clavate. Basidioles 13–25 x 4.0–9.0 μm , clavate, (sub)fusoid, subcylindrical. Cheilocystidia shaped as broom-cells of the Siccus-type, 14–22 x 5.0–9.0(–11) μm , clavate, subcylindrical, entirely thin-walled or with slightly thick-walled apex, hyaline, with up to 10 thin- to slightly thick-walled, nodulose, obtuse to subacute, up to 7.0 x 1.0 μm projections; mixed with scattered smooth, clavate, subvesiculose cells with present transient forms. Pleurocystidia numerous, 32–59 x 8.0–17 μm , fusoid, subutriform, (sub)clavate, obtuse, often rostrate or with a pimple, thin-walled, with a refractive contents. Hymenophoral trama composed of cylindrical to subinflated, thin-walled, up to 12 μm wide hyphae. Pileipellis a hymeniderm composed of broom-cells of the Siccus-type, 11–20 x 7.0–12 μm , clavate, subcylindrical, thin-walled with slightly thick-walled apex, with c. 12–25 nodulose, obtuse to subacute, slightly thick-walled, up to 11 x 1.0(–1.5) μm projections. Stipitipellis a cutis consisting of cylindrical, parallel, slightly thick-walled, smooth, up to 4.0(–5.0) μm wide hyphae. Caulocystidia absent. Clamp-connections present in all tissues.

Chemical reactions: Hymenophoral trama hyphae dextrinoid, other structures non-dextrinoid.

Ecology. Saprotrophic, growing on leaf litter in mixed miombo woodland where dominant trees were *Brachystegia spiciformis* and *Julbernardia globiflora*.

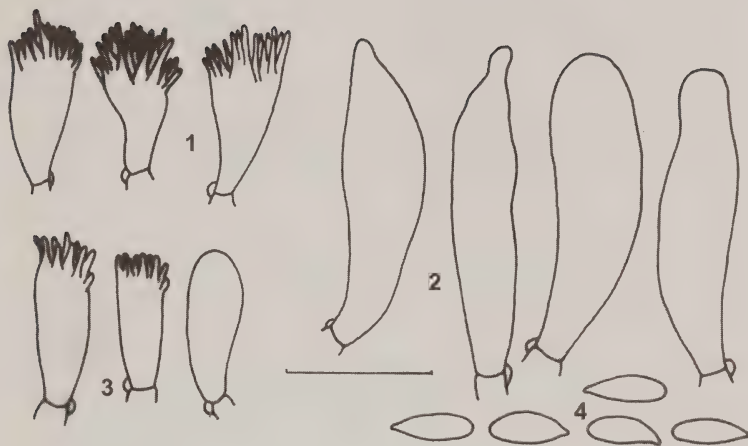
Distribution. Known only from a few localities in Zimbabwe.

Revised specimens. Zimbabwe, Bromley, Liemba Farm 1831 A2, 3 Febr. 1999 leg. C. Sharp 1321/99 (holotype, BRNM 699715). – Zimbabwe, Karoi North, Ridges Farm 1629 DI, 15 March 2001 leg. D. Flight (Sharp 1558/01; BRNM 699714).

Remarks. *Marasmius cremeopileatus* is characterised by having pale (buff or cream) coloured carpophores, moderately large basidiospores, well-developed pleurocystidia and cheilocystidia, and pileipellis cells in the form of broom-cells of the Siccus-type; caulocystidia are absent. On account of these characteristics, it belongs to sect. *Sicci*, ser. *Haematocephali*.

The closest tropical African species is *M. pallidopileatus* Antonín (Antonín 2006), with a smaller, yellow-ochraceous pileus only up to 10 mm broad, a very pale, brownish stipe, and cheilocystidia of only one type – only in the form of broom-cells.

Among other species, *Marasmius splitgerberi* (Mont.) Singer collected in South America and Lesser Antilles seems to be a similar species. However, it differs by a smaller, only 2–11 mm broad pileus, larger basidiospores (10–15 x 3–4 μm according to Pegler 1983; (7–)9–12.5 x 2.7–4 μm according to Singer 1976), and inconspicuous pleurocystidia measuring 25–36 x 7–9 μm . *Marasmius musicola* Murrill known from Cuba and



Figs. 1–4. *Marasmius cremeopileatus*:

1. pileipellis cells, 2. pleurocystidia, 3. cheilocystidia, 4. basidiospores.

Scale bar = 20 μm .

Guadeloupe, has a smaller, 8–10 mm broad, sulcate-striate pileus, very distant lamellae ($L = 6\text{--}11$), larger basidiospores ($15.5\text{--}19 \times 2.5\text{--}4 \mu\text{m}$ according to Pegler 1983; $16.8\text{--}20.5 \times 3.2\text{--}4.5 \mu\text{m}$ according to Singer 1976), and pleurocystidia with coarse oily contents (Pegler 1983, Singer 1976).

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Myxomycete flora of Derebucak (Konya) and Akseki (Antalya) districts in Turkey

DURSUN YAĞIZ & AHMET AFYON

dyagiz@selcuk.edu.tr aafyon@selcuk.edu.tr

Selçuk University, Education Faculty, 42099, Meram, Konya-TURKEY

Abstract—This study was based on myxomycete specimens collected from Derebucak (Konya) and Akseki (Antalya) district between 2002 and 2004. According to the “Natural” or “Moist Chamber Cultures” techniques, 47 taxa belonging to 17 genera from nine families have been identified. These taxa are listed in alphabetical order and provided in the result section. This list includes information on epithet, author, locality, habitat, altitude, date, and herbarium number for each taxon. The full checklist is available at <http://www.egitim.selcuk.edu.tr/fen/yagiz/pdf/mycotaxon06-092.pdf>.

Key words—Myxomycota, diversity, C3 floristic square

Introduction

This study was based on myxomycete specimens collected from Derebucak (Konya) and Akseki (Antalya) district between 2002 and 2004 (Figure 1). The study area is located in the C3 floristic square of Central Anatolia and Mediterranean regions (Davis 1965–1985). The first type of the east Mediterranean climate is seen in Derebucak and Akseki. While winter is the rainiest season for the Mediterranean climate, summer seasons are very dry (Akman 1990). Two important phytogeographic regions and their transition zone form the study area. Hence, Derebucak and its surrounding are in the Iran-Turan region and Akseki is in the Mediterranean phytogeographic region. This forest environment, formed by mixed and pure conifer and broad-leaved trees such as *Pinus* spp., *Abies* sp., *Cedrus* sp. and *Quercus* spp., forms an important part of the study area (Dural et al. 1995, Duran 2002). This research aims to find out the bio-diversity and distribution of myxomycetes in Turkey.

Materials and Methods

The myxomycetes were collected from the research area during field trips between 2002 and 2004. These samples come from the bark of trees, decaying wood, and litter collected during various field trips. Where myxomycetes were in the natural sporophore phase, these were collected with their substrates. The materials not carrying the naturally developed myxomycete sporophore were treated with the “Moist Chamber Cultures” method, developed by Gilbert & Martin (1933) in order to grow myxomycetes that might potentially develop spores. The incubated materials were examined periodically with a

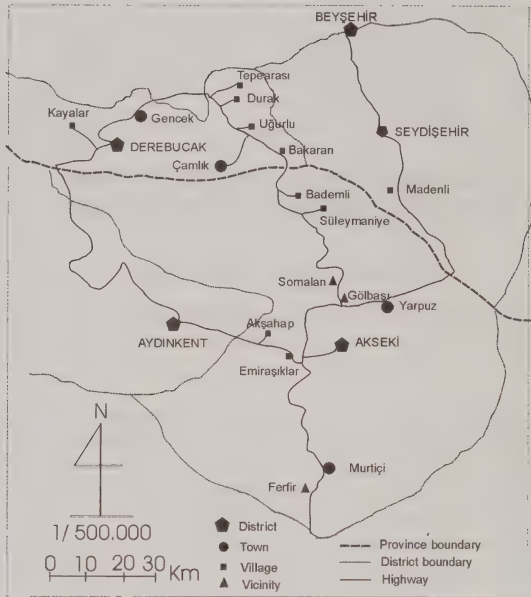


Figure 1: Map of the study area.

stereomicroscope. The preparations were examined under the microscope to determine the microscopic characteristics of the myxomycetes. A variety of resources were used to identify the samples (Martin & Alexopoulos 1969, Thind 1977, Farr 1981, Martin et al. 1983, Nannenga-Bremekamp 1991, Neubert et al. 1993, 1995, 2000, Stephenson & Stempen 2000). The myxomycete samples are kept in the herbarium of the Faculty of Education at the Selçuk University (KNYA).

Results

In this study, 47 taxa belonging to 17 genera from nine families were identified. All taxa are listed in alphabetical order in the full checklist posted at <http://www.egitim.selcuk.edu.tr/fen/yagiz/pdf/mycotaxon06-092.pdf>. Distribution of the taxa according to their families is as follows: *Ceratiomyxaceae* 1, *Echinosteliaceae* 1, *Cribrariaceae* 8, *Reticulariaceae* 1, *Liceaceae* 5, *Didymiaceae* 1, *Physaraceae* 8, *Trichiaceae* 12 and *Stemonitaceae* 10.

Discussion

A total of 47 taxa representing 17 genera from nine families were determined. The percentage of the species by family are: *Trichiaceae* 25.5 %, *Stemonitaceae* 21.3 %, *Cribrariaceae* 17 %, *Physaraceae* 17 %, *Liceaceae* 10.6 %, *Ceratiomyxaceae* 2.1 %, *Didymiaceae* 2.1 %, *Echinosteliaceae* 2.1 % and *Reticulariaceae* 2.1 %. A relatively large number of taxa were identified within the limited area of this study, particularly when compared to other studies conducted over large areas.



Figure 2: Photo of a myxomycete sporophore — *Stemonitopsis hyperopta*

The usual habitats for the myxomycetes are forest areas. Naturally developed sporophores of myxomycetes identified are marked with an asterisk (*) in the list of taxa. These naturally sporulating samples represent 23.4 % of the total samples. Such a high percentage shows the availability of the suitable media for the development of myxomycetes.

Using the method of “Moist Chamber Cultures” enables us to grow myxomycetes without depending on the conditions of each season. In the laboratory, the spores of some naturally collected myxomycetes were used to produce the fruit body by the incubation technique. However, myxomyceticolous hyphomycetes and ascomycetes grow particularly fast during the hot summer months (July-August), which can greatly hamper the incubation success rate. The mycelia of the myxomyceticolous fungi were particularly common on species of *Comatricha* and *Stemonitis*. This result parallels the one found by Stephenson & Stempen (2000).

It was noted that the members of *Stemonitales* and *Trichiales* were often developed on dead wood of conifers. This finding is similar to the one suggested by Härkönen & Ukkola (2000).

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A taxonomical treatment of the North and Central American species in *Lactarius* sect. *Deliciosi*

JORINDE NUYTINCK

jorinde.nuytinck@ugent.be

*Ghent University, Department of Biology, Research Group Mycology
K.L. Ledeganckstraat 35, B – 9000 Ghent Belgium*

STEVEN L. MILLER

*University of Wyoming, Botany Department
Laramie, WY 82071–3165 USA*

ANNEMIEKE VERBEKEN

*Ghent University, Department of Biology, Research Group Mycology
K.L. Ledeganckstraat 35, B – 9000 Ghent Belgium*

Abstract — This paper deals with the 13 American species in *Lactarius* sect. *Deliciosi* that are supported or revealed in a molecular phylogenetic study of this section on a worldwide scale. Elaborate macro- and microscopical descriptions are given and illustrated for every species. Type specimens for nearly all taxa were examined in this study. None of the taxa treated here seems to occur in Asia or Europe. The name *L. deliciosus* is misapplied in North America but more research is needed to solve the taxonomy and relationships in this complex of varieties of “*L. deliciosus*”. *Lactarius aurantiosordidus* is described as a new species.

Key words — morphology, *Lactarius* sect. *Dapetes*

Introduction

In North and Central America, *Lactarius indigo* is the most striking representative of *Lactarius* sect. *Deliciosi* (Fr. : Fr.) Redeuilh et al. (syn. *L.* sect. *Dapetes* (Fr. ex J. Kickx f.) Burl., syn. *L.* subgenus *Lactarius* sensu Hesler & Smith 1979). It differs from the other species in the section by its deep blue coloured latex. Most representatives have orange latex that turns more or less slowly reddish or have vinaceous red to brown latex from the beginning. The basidiocarps are similarly coloured but often paler due to the presence of a whitish layer covering the surface of the pileus and stipe. Other characteristic features are the mostly viscid pileus, and in some species also the viscid stipe, the often zonate pileus, the frequent presence of scrobicules and the green stains that develop upon bruising or with age.

Lactarius indigo was also the first species that was described from North America in this section (as *Agaricus indigo* by Schweinitz (1822), later also by Winder (1871) as *L. canadensis*). Peck (1872, 1878, 1898) contributed to the knowledge of *Lactarius* sect. *Deliciosi* in America by describing *L. chelidonium*, *L. subpurpureus* and *L. salmoneus*. Coker (1918), Beardslee & Burlingham (1940), and Murrill (1945) furthermore described *L. curtisii*, *L. paradoxus*, *L. pseudodeliciosus* and *L. paradoxiformis*. Hesler & Smith (1960) published an important revision in which they divide *Lactarius* sect. *Lactarius* (= sect. *Deliciosi*) into three subsections. The pileipellis structure was considered very important. *Lactarius* subsection *Versicolores* Hesler & A.H. Sm. contains species with a dry pileus: *L. salmoneus*, *L. curtisii* and *L. subaustralis* Hesler (the latter species was later transferred to *Lactarius* subgenus *Plinthogali*). *Lactarius* subsection *Lactarii* contains species with a viscid pileus and thus includes most species; a separate subsection *Caerulei* Hesler & A.H. Sm. was created for *L. indigo*. Most European species known at that time were treated in Hesler & Smith (1960); some of them were also recognised to occur in North America (*L. salmonicolor*, *L. sanguifluus* (Paulet) Fr., *L. deliciosus* (L.: Fr.) Gray var. *deliciosus* and *L. quieticolor* Romagn.). In their later monograph of the genus *Lactarius* in North America, Hesler & Smith (1979) raise the section to the level of subgenus and give up their subdivision of *Lactarius* subgenus *Lactarius* (= sect. *Deliciosi*). Furthermore, many European taxa are no longer included; the European names still present are *L. salmonicolor*, *L. deliciosus* var. *deliciosus*, var. *deterimus* (Gröger) Hesler & A.H. Sm. and var. *piceus* Smotl. However, in an appendix listing extralimital species that have been reported from North America and are expected to be eventually verified, they mention many European taxa. Four new species and varieties were described by Hesler & Smith (1979) (*L. barrowsii*, *L. indigo* var. *diminutivus*, *L. rubrilacteus* and *L. deliciosus* var. *olivaceosordidus*) and four combinations were made. The many recognised varieties indicate uncertainty about the status of several taxa, but Hesler & Smith (1979) explicitly stated that they wanted to stress the diversity in the genus. Since then, only two new species have been described: *L. miniatosporus* and the hypogeous *L. rubriviridis* from Central and North America (Montoya & Bandala 2004, Desjardin 2003).

A molecular approach, using two DNA regions and including 33 North and Central American collections, support 13 species in *Lactarius* sect. *Deliciosi* for the area (Nuytinck et al. in preparation). Many of the described varieties, however, were not included. This paper lists all the species in *Lactarius* sect. *Deliciosi* that we provisionally recognise in North and Central America. For every species a macroscopical description is given, often based on literature data, and a detailed microscopical description is elaborately illustrated. A short discussion summarizes the most important diagnostic features of each species and conclusions from our molecular phylogenetic approach (Nuytinck et al. in preparation). For most species, the type specimen was examined. The status of the many varieties and the delimitation of taxa in the "*L. deliciosus*" complex remain problematic. Molecular data show that the name *L. deliciosus* is misapplied in North and Central America (Nuytinck 2005).

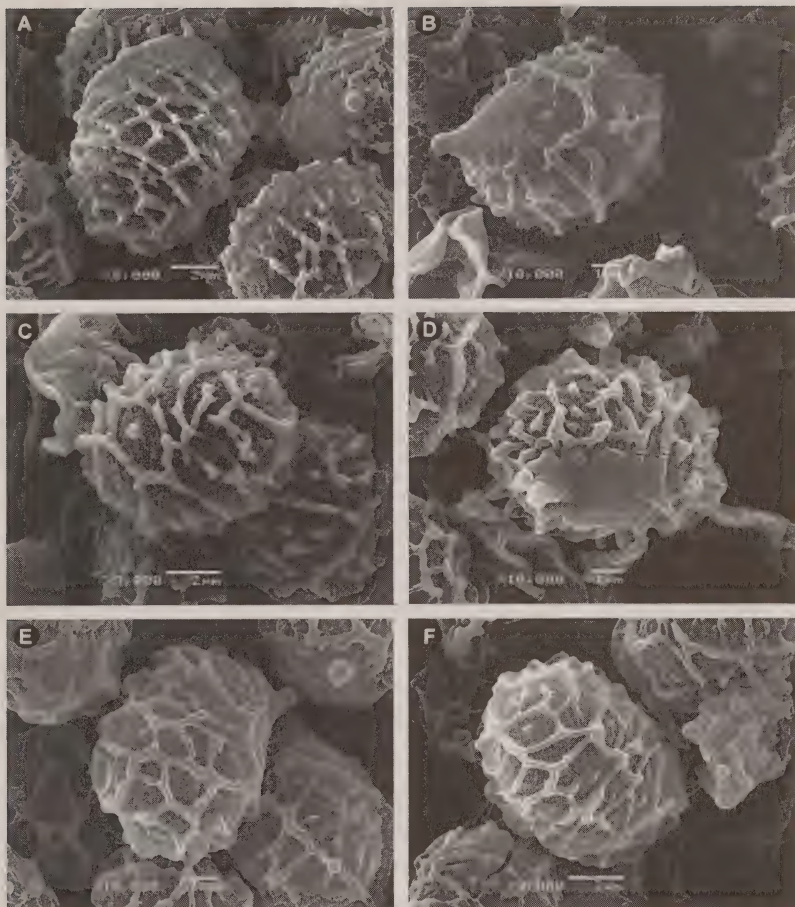


Fig. 1: SEM images of spores A. *L. barrowsii* (J. States AEF 1151); B. *L. chelidonium* (S.L. Miller 9649); C. *L. indigo* (R.E. Halling 8143); D. *L. paradoxus* (G.S. Burlingham 184233, lectotype); E. *L. pseudodeliciosus* var. *pseudodeliciosus* (Beardslee & Burlingham 22.12.1937, lectotype); F. *L. rubrilacteus* (J. States AEF 1055).

Materials & Methods

This study is based on herbarium material deposited in or obtained from FLAS, GENT, MICH, NY, NYS, PC, RMS, SFSU, XAL and ZT.

Macroscopical characters are based on fresh material or are compiled from literature. Colour codes are from Kornerup & Wanscher (1962). Microscopic measurements and drawings were made under oil immersion at 1000 $\times$ with a Zeiss Axioscop 2 microscope

and drawing tube. All observations and measurements (except for the spores) were made in Congo red in L_4 (7.2 g KOH, 160 ml glycerine, 840 ml dH_2O , 7.6 g NaCl and 5 ml Invadin (Ciba-Geigi), Cléménçon 1972). Where necessary a short pre-treatment in 10% KOH was used to rehydrate the tissue. Basidia lengths exclude sterigmata lengths. We use the term cheileptocystidia for the thin-walled, mostly clavate to irregularly shaped cystidia, without specific content and with a rounded apex on the lamella edge. Observations and measurements of basidiospores were made in Melzer's reagent. Spores were measured in side view, excluding ornamentation and the measurements are given as (MIN) $[Ava-2 \times SDa] - Ava - Avb - [Avb+2 \times SDb]$ (MAX) in which Ava = lowest mean value for the measured collections, Avb = greatest mean value and SDa/b = standard deviation of the lowest and greatest mean value respectively. MIN is the lowest value measured, MAX the highest value; MIN and MAX are only given when they exceed $[Ava-2 \times SDa]$ or $[Avb+2 \times SDb]$ respectively. Q stands for 'quotient length/width' and is given as $MINQ - Qa - Qb - MAXQ$ in which Qa and Qb stand for the lowest and the highest mean quotient for the measured specimens respectively. $MINQ/MAXQ$ stands for the minimum/maximum value over the quotients of all available measured spores. 20 spores were measured for every collection mentioned in the examined collections section. For species that are microscopically described using only one specimen, the measurements are given as (MIN) $[Av-2 \times SD] - Av - [Av+2 \times SD]$ (MAX) in which Av is the mean value of the 20 spores measured from that collection and as $MINQ - Q - MAXQ$ in which Q stands for the mean quotient of the measured spores.

Scanning electron photographs were taken with a JEOL JSM-5600 LV microscope. Small pieces of lamellae were taken from dried specimens and soaked overnight in strongly diluted ammonia. The material was then treated with 70% ethanol (2×15 min.) and dimethoxymethane (2×30 min.), before being submitted to the process of critical point drying. This was done with a BAL-TEC CDP 030 dryer. The samples were then coated with gold in a JEOL JFC-1200 Fine Coater for 60 sec. at 8 Pa and 30 mA, until a 15 nm thick layer covered the spores.

Synoptic key to the representatives of *Lactarius* sect. *Deliciosi* in North and Central America

Numbers refer to the species as treated in the text. The hypogeous *L. rubriviridis* is excluded from this synoptic key. For several characters the state remains unknown for some of the species. For *L. pseudodeliciosus* var. *paradoxiiformis* and *L. salmoneus* var. *salmoneus*, e.g., it is not known whether they have a zonate pileus and scrobicules on the stipe. The colour change of the latex on the context (after ± 30 min.), an important identification character, is unclear for, e.g., *L. chelidonium*, *L. pseudodeliciosus* and *L. salmoneus*.

Pileus colour

- whitish to buff: 1, 6.1, 6.2, 9.1, 9.2
- yellow: 2.1, 2.2, 4, 6.1
- orange: 2.2, 7, 9.2, 11, 12.1, 12.2, 13
- pinkish: 4, 10
- greyish green: 2.1, 2.2, 5, 12.1, 12.2, 13
- blue: 2.1, 2.2, 3.1, 3.2, 5

Pileus zonation

- azonate to faintly zonate: 1, 2.1, 2.2, 3.1, 3.2, 4, 6.1, 9.2, 12.1
- zonate: 2.1, 3.1, 3.2, 5, 7, 10, 11, 12.1, 12.2, 13

Lamellae colour

- orange to ochraceous: 1, 5, 6.1, 6.2, 7, 9.1, 9.2, 11, 12.1, 12.2, 13
- yellowish: 2.1, 2.2, 6.1
- pinkish: 4, 5, 10
- blue: 3.1, 3.2

Stipe colour

- whitish to yellowish: 1, 2.1, 2.2, 6.1, 6.2, 9.1, 9.2
- orange: 2.2, 7, 9.2, 11, 12.1, 12.2, 13
- pinkish to red: 4, 5, 7, 10
- greyish green: 2.1, 13
- blue: 2.1, 3.1, 3.2

Stipe scrobiculate

- no: 1, 2.2, 3.2, 4, 7, 10, 11, 12.1, 12.2, 13
- yes: 3.1, 3.2, 4, 5, 6.1, 7, 10, 11, 12.1, 13

Latex colour (on context when cut)

- orange: 2.2, 6.1, 6.2, 9.1, 9.2, 11, 12.1, 12.2, 13
- yellow: 2.1, 2.2
- red: 1, 4, 5, 7, 10
- blue: 2.1, 2.2, 3.1, 3.2, 5
- greenish: 13

Latex colour changing on context (after $\pm$ 30 min.)

- orange to red: 9.1, 11, 12.1, 12.2
- no change: 1, 3.1, 3.2, 4, 5, 7, 10, 12.2

Discolouration of sporocarp

- becoming green: 1, 2.1, 2.2, 3.1, 3.2, 4, 5, 6.1, 6.2, 7, 9.2, 10, 12.1, 12.2, 13
- not changing to green: 9.1, 11

Host tree

- *Pinus*: 1, 2.1, 2.2, 3.1, 3.2, 4, 5, 6.1, 7, 9.1, 9.2
- *Quercus*: 3.1, 5, 6.1
- *Pseudotsuga*: 7
- *Tsuga*: 10
- *Picea*: 12.2, 13

Locality

- western North America: 1, 7, 12.1, 12.2, 13
- eastern North America: 2.1, 2.2, 3.1, 3.2, 5, 6.1, 6.2, 9.1, 9.2, 10, 11
- Central America: 3.1, 4, 5, 9.2

Descriptions and taxonomical conclusions

1. *Lactarius barrowsii* Hesler & A.H. Sm., N. Amer. Species *Lactarius*: 74 (1979)

Figs. 1, 2

Type: Barrows 35 of 1969 (MICH!), USA: New Mexico, near Santa Fe

DESCRIPTION (macroscopical description after Hesler & Smith 1979): Pileus 3–10 cm diam., convex to depressed with an incurved margin; surface glabrous, viscid but soon dry, azonate or only near the margin faintly zoned; colour whitish to light pinkish cinnamon at first, becoming mottled creamy to ochraceous orange or finally $\pm$ pinkish buff, often flushed green or olive or more olive-grey. Lamellae becoming decurrent, close, narrow; colour ochraceous to pinkish orange, becoming flushed green, green where injured. Stipe 2–4 $\times$ 1–2.5 cm, equal or nearly so, soon hollow; surface dry, not scrobiculate, at first with a white bloom, yellowish beneath this but soon stained green. Context firm, thick; colour whitish to pale pinkish cinnamon (especially around worm-holes), becoming flushed greenish, staining green quickly where cut; taste mild to peppery. Latex scanty, dark red (port-wine red). Spore deposit yellowish.

Spores 8.5–9.3–9.4–10.1 (10.4) $\times$ 6.3–7.0–7.1–7.6 (7.8) μm , broadly ellipsoid to ellipsoid ($Q = 1.22\text{--}1.31\text{--}1.34\text{--}1.48$); ornamentation up to 0.5 μm high, of medium thick ridges with some thinner ridges and isolated warts, forming a nearly complete reticulum with small meshes; plage distally weakly amyloid. Basidia 42–60 $\times$ 7–11 μm , subclavate, 4-spored, with a needle-shaped content. Pleuromacrocystidia scarce and inconspicuous, 39–50 $\times$ 4.7–8 μm , slightly emergent, subfusiform with a moniliform or narrowing apex, often with an ochre, smooth content or with small needle-shaped crystals, thin-walled. Pseudocystidia rather abundant, 2–6 μm broad, sometimes slightly emergent, tortuous, content oleiferic and ochre-brownish in KOH. Lamella edge mostly fertile and with abundant cheilomacrocystidia and basidioles; cheilomacrocystidia 34–50 $\times$ 5–7 μm , emergent, subfusiform with a moniliform to obtuse or capitate apex, with a needle-like to granular content, thin-walled. Subhymenium composed of small, $\pm$ rounded cells. Hymenophoral trama irregularly filamentous; lactifers abundant. Pileipellis an ixocutis, 100–200 μm thick, slime layer thin and inconspicuous, composed of regularly shaped, densely interwoven hyphae, 2–7 μm diam., shrivelled hyphae scarce. Stipitipellis a very dense cutis, up to 100 μm thick, of regularly shaped hyphae, 2–4 μm diam. Clamp-connections absent.

HABITAT: Scattered under *Pinus ponderosa* and *Pinus cembroides* in montane habitat (type locality, Hesler & Smith 1979).

DISTRIBUTION: Reported from New Mexico, Washington and Arizona.

COLLECTIONS EXAMINED: USA, New Mexico, Santa Fe Co., Near Santa Fe, Under Pinon pine, 01.09.1969, C.A. Barrows 35 (MICH), holotype – Washington, Spokane, Whitworth College Campus near MacKay Hall, 18.09.1978, leg. N. Gray (RMS) – Arizona, Cochise Co., east side Onion Saddle, Turkey Creek Road, Coal outcrop, 1620 m a.s.l., 03.09.1993, J. States AEF 987 (MICH) – Arizona, Cochise Co., Pinery Canyon Road, *Pinus*, 04.09.1993, J. States AEF 1039 (MICH) – Arizona, Santa Cruz Co., Santa Rita Mountains, 03.09.1994, J. States AEF 1271 (MICH) – Arizona, Coconino Co., Walnut Canyon National Monument, *Pinus edulis*, N35°10' W111°30.26', 10.09.1994, J. States AEF 1151 (MICH).

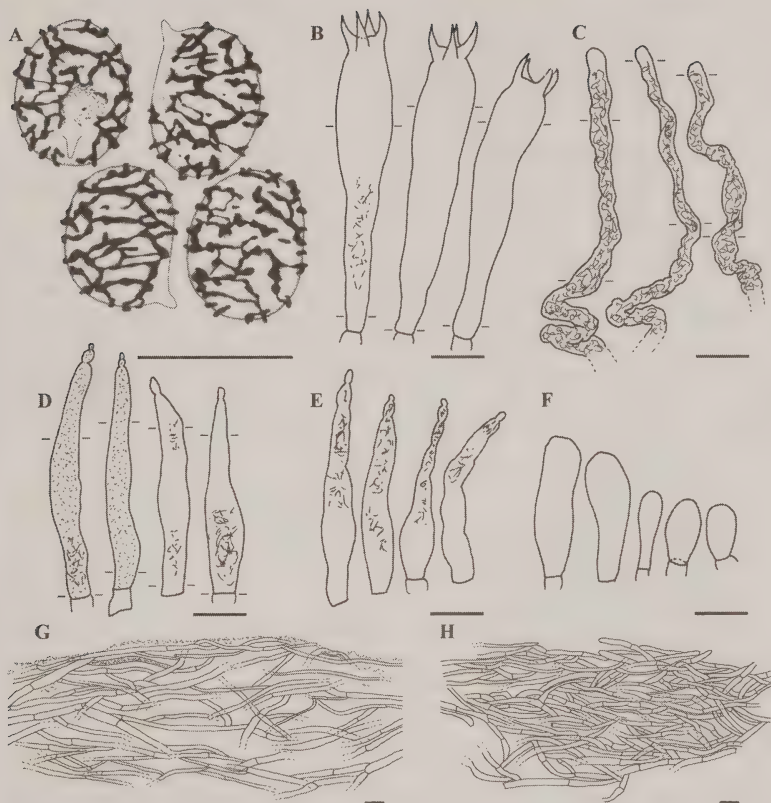


Fig. 2: *Lactarius barrowsii*: A. spores; B. basidia; C. pseudocystidia; D. pleuromacrocyttidia; E. cheilomacrocyttidia; F. basidioles and marginal cells from the lamella edge; G. section through the pileipellis; H. section through the stiptipellis. From C.A. Barrows 35 (type), J. States AEF 987, J. States AEF 1039, J. States AEF 1271 and J. States AEF 1151.

Scale bars = 10 μ m, small bars indicate the height of the hymenium.

DISCUSSION: Hesler & Smith (1979) remark that this species is amply distinct in the colour of the pileus from the other western American species with red latex, *L. rubrilacteus*. The latter species has an orange coloured and clearly zoned pileus. Both species also differ in spore size and ornamentation. *Lactarius barrowsii* has larger spores that are ornamented with a denser and more complete reticulum. Another striking feature of *L. barrowsii* is the frequently fertile lamella edge and as a consequence the occurrence of basidioles on the edge. *Lactarius barrowsii* is so far only known from New Mexico, Washington and Arizona and seems to be associated with *Pinus* spp. in mountainous habitat. We included two *L. barrowsii* specimens (originating from Arizona and Washington) in

our phylogenetic analyses. They form a well-supported clade and group with a high confidence value with *L. rubriviridis*, a hypogeous species described from California and collected in the same type of habitat as *L. barrowsii*. *Lactarius barrowsii* does not seem to be very closely related to *L. rubrilacteus*.

2.1. *Lactarius chelidonium* Peck, Rep. (Annual) New York State Mus. Nat. Hist. 24: 74

(1872) **var. *chelidonium***

Figs. 1, 3

Holotype: missing from NYS, collected by Peck in New York, Saratoga.

DESCRIPTION (macroscopy after Peck 1872): Pileus fleshy, firm, centrally depressed; surface smooth, slightly viscid, of a greyish green colour with blue and yellow tinges and a few narrow zones on the margin. Lamellae close, narrow, forked and wavy at the base, sometimes anastomosing; colour greyish yellow. Stipe short, subequal, hollow; surface smooth; coloured like the pileus. Context when bruised at first stained yellowish, then changing to blue and finally to green. Latex sparse, of a yellowish colour resembling the juice of Celandine (*Chelidonium majus*) or the liquid secreted from the mouth of grasshoppers; taste mild. Spore deposit yellowish.

Spores (8.0) 8.1–8.6–9.2 (9.3) $\times$ 5.9–6.4–7.0 μm , broadly ellipsoid to ellipsoid ($Q = 1.24\text{--}1.35\text{--}1.48$); ornamentation up to 0.5 μm high, of medium thick ridges and quite abundant isolated warts, forming an incomplete reticulum; plage distally amyloid or with scattered, small amyloid spots. Basidia 40–55 $\times$ 8–10 μm , subclavate, 4-spored, sometimes with a needle-shaped content; sterigmata 4–6 μm long. Pleuromacrocystidia scarce, 45–65 $\times$ 4.5–7 μm , emergent, subfusiform with a narrowed to strongly constricted (moniliform) apex, sometimes with a needle-shaped content, thin-walled. Lamella edge sterile with abundant cheilomacrocystidia; cheiloleptocystidia 12–25 $\times$ 3–6 μm , subclavate to irregular, hyaline, thin-walled; cheilomacrocystidia 30–40 $\times$ 4.5–7 μm , emergent, subfusiform with a tapering, capitate or moniliform apex, with a needle-like content, thin-walled. Subhymenium of irregularly shaped cells, often arranged in short rows. Hymenophoral trama with abundant lactifers of 4–9 μm diam. Pileipellis an ixocutis, 100–200 μm thick. Clamp-connections absent.

HABITAT: Sandy soil, under pine trees (type locality, Peck 1872).

DISTRIBUTION: Hesler & Smith (1979) cite collections from Alabama, Michigan, Tennessee and Wisconsin. The type locality is in New York.

COLLECTIONS EXAMINED: USA, New York, Bolton Landing, August 1921, C.H. Peck (NYS) – New York, Bethlehem, September 1921, C.H. Peck (NYS) – New York, St. Lawrence Co., near Star Lake, pine woods, 26.09.1997, S.L. Miller 9649 (RMS).

DISCUSSION: Hesler & Smith (1979) state that *L. chelidonium* has been generally misidentified since Peck's time, which has led to much confusion with "*L. deliciosus*". The yellowish colour of the latex and the greyish and bluish tinges in the cap should make a clear distinction between both species possible. The blue colour of the pileus context is independent of the very commonly observed change to green in this section. This has been wrongly interpreted since the time of Peck (Hesler & Smith 1979). As the type of *L. chelidonium* is missing, we examined two collections identified by Peck. However, the collection from Bolton landing is in a very bad state.

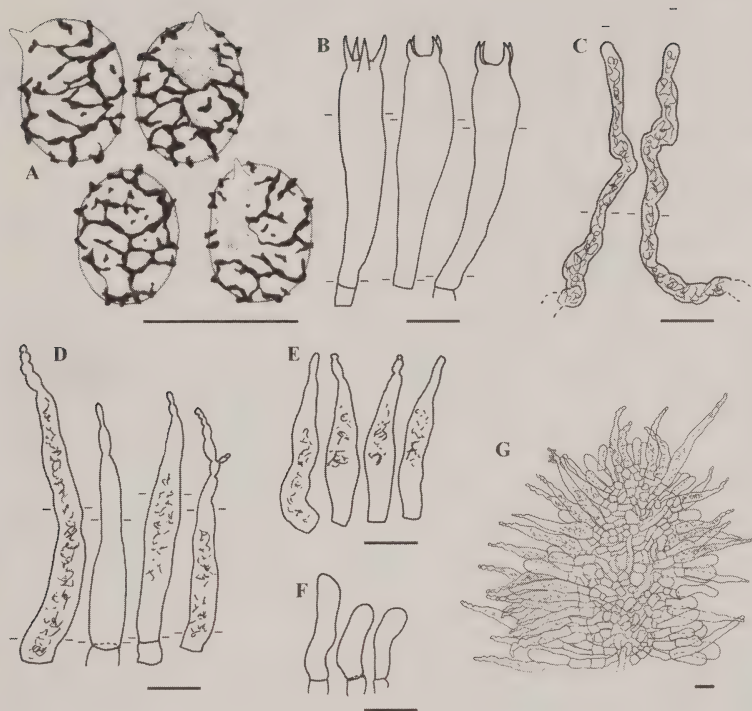


Fig. 3: *Lactarius chelidonium* var. *chelidonium*: A. spores; B. basidia; C. pseudocystidia; D. pleuromacrocystidia; E. cheilomacrocystidia; F. cheileleptocystidia; G. lamella edge. From Bethlehem, September 1921, C.H. Peck and S.L. Miller 9649.

Scale bars = 10 µm, small bars indicate the height of the hymenium.

Collection S.L. Miller 9649 (RMS) from New York was identified as *L. chelidonium* in the field and is included in our molecular analyses. Because the microscopical features are slightly deviating from the ones observed in Peck's material, a short description is given here separately.

Spores $7.8\text{--}8.4\text{--}8.9 \times 5.8\text{--}6.4\text{--}6.9$ (7.0) µm, broadly ellipsoid to ellipsoid ($Q = 1.25\text{--}1.32\text{--}1.37$); ornamentation up to 0.5 µm high, of medium thick ridges and some isolated warts, forming an incomplete reticulum; plage distally amyloid or with scattered amyloid spots. Basidia $37\text{--}55 \times 8\text{--}12$ µm, subclavate, mostly 4-spored, sometimes 2-spored, mostly hyaline; sterigmata $4\text{--}7$ (8) µm long. Pleuromacrocystidia quite abundant, $35\text{--}70 \times 5.3\text{--}7$ µm, emergent, subfusiform with a narrowing to moniliform apex, with a granular or needle-shaped content, thin-walled. Pseudocystidia relatively scarce, $2.5\text{--}5.5$ µm broad, subcylindric to tortuous, with a yellowish content. Lamella edge sterile with very abundant cheilomacrocystidia; cheileleptocystidia $12\text{--}30 \times 4\text{--}6$ µm, mostly

subclavate, hyaline, thin-walled; cheilomacrocytidia $27\text{--}58 \times 4\text{--}8\text{ }\mu\text{m}$, subfusiform with a narrowing apex, with a granular to needle-shaped content, thin-walled.

This collection differs from the collections made by Peck by the abundant cheilo- and pleuromacrocytidia. Macrocytidia are only abundant in a zone of $100\text{ }\mu\text{m}$ close to the lamella edge in Peck's collections. More collections are needed to find out whether these differences fall into the intraspecific variation of *L. chelidonium*.

2.2. *Lactarius chelidonium* var. *chelidonioides* (A.H. Sm.) Hesler & A.H. Sm.,

N. Amer. Species *Lactarius*: 84 (1979)

Fig. 4

= *L. chelidonioides* A.H. Sm., Brittonia 12: 127 (1960)

Holotype: Smith 62026 (MICH!), USA: Michigan, Dexter

DESCRIPTION (macroscopy after Hesler & Smith 1979, Kuo 2003): Pileus 3–8 cm diam., appanate to convex or shallowly depressed, becoming shallowly infundibuliform; surface smooth or finely roughened, glabrous, viscid but soon dry, azonate to slightly zonate, often mottled with watery spots; colour dirty bluish when young, passing through stages of yellowish brown and dull orange, readily bruising dark green, in age often green overall. Lamellae decurrent, narrow, fairly crowded; colour dull dingy yellowish to tawny olive (yellow-brown) but soon discolouring greenish, in old basidiocarps olive buff overall and stained darker green locally. Stipe 3–6 (8) $\times$ 1–2.5 cm, equal or enlarged below; surface fairly smooth, glabrous, dry, without scrobicules; colour similar to the cap but paler and more dingy yellowish orange at the base. Context becoming hollow in the stipe, pallid, staining azure blue in the upper half of the pileus, with a paler to dingy yellowish line above the lamellae, dingy pale yellow-brown in the cortex of the stipe, in age azure blue throughout except for the line above the lamellae and dirty yellowish orange in the stipe; smell subnauseous, like that of *Morchella esculenta*; taste tardily and slightly peppery. Latex very scarce (likely to be observed only in very young primordia), dirty yellowish to yellowish brown. Spore deposit pale buff.

Spores $8.1\text{--}8.7\text{--}9.2 \times 5.9\text{--}6.6\text{--}7.0\text{ }\mu\text{m}$, broadly ellipsoid to ellipsoid ($Q = 1.27\text{--}1.35\text{--}1.42$); ornamentation up to $1\text{ }\mu\text{m}$ high, of large isolated warts and some rather short and medium thick ridges, not organized into a reticulum or only a very incomplete one; plage distally slightly amyloid. Basidia $40\text{--}65 \times 8\text{--}11\text{ }\mu\text{m}$, subclavate, 4-spored, mostly hyaline; sterigmata $3\text{--}7\text{ }\mu\text{m}$ long. Pleuromacrocytidia absent but macrocytidia abundantly present very close to the edge (see under lamella edge). Pseudocyttidia rather scarce, $2.5\text{--}5\text{ }\mu\text{m}$ broad, cylindrical to tortuous, with an ochre-yellow content. Lamella edge sterile with abundant macrocytidia $100\text{--}150\text{ }\mu\text{m}$ away from the edge, no real cheilomacrocytidia; cheileptocytidia $7\text{--}22 \times 3.5\text{--}7.5\text{ }\mu\text{m}$, mostly subclavate, hyaline, thin-walled; macrocytidia close to the edge $40\text{--}60 \times 4.5\text{--}10\text{ }\mu\text{m}$, subfusiform, with a moniliform apex, mostly hyaline, thin-walled. Subhymenium or irregularly shaped cells, arranged in short rows. Hymenophoral trama of interwoven, mainly irregularly arranged hyphae and abundant lactifers. Pileipellis an ixocutis of narrow, gelatinous, hyaline and appressed hyphae. Stipitipellis a cutis. Clamp-connections absent.

HABITAT: Under conifers, especially *Pinus strobus* and *Pinus resinosa*, late summer and fall.

DISTRIBUTION: Uncertain but probably limited to eastern North America; recorded in Michigan, Massachusetts, Vermont, Illinois and Quebec (Kuo 2003).

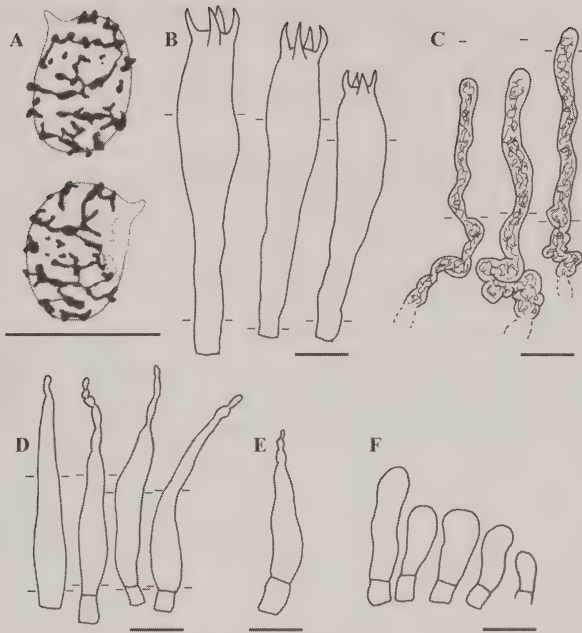


Fig. 4: *Lactarius chelidonium* var. *chelidonioides*: A. spores; B. basidia; C. pseudocystidia; D. pleuromacrocytidia; E. macrocystidium close to the lamella edge; F. cheiloleptocystidia. From A.H. Smith 62026 (type). Scale bars = 10 μ m, small bars indicate the height of the hymenium.

COLLECTION EXAMINED: USA, Michigan, Washtenaw Co., Stinchfield Woods, NW of Dexter, Under *Pinus strobus*, 12.10.1972, A.H. Smith 62026 (MICH), holotype.

DISCUSSION: Originally, Hesler & Smith (1960) described *L. chelidonioides* as a separate species, differing from *L. chelidonium* by its muddy yellow to brownish latex, its *Morchella*-like smell and the blue context of pileus. The colour of the context was observed at all stages from buttons 1 cm in diameter to the largest caps, and it became more intense and widespread up to maturity. In old basidiocarps the colour had faded out to greyish pallid (Hesler & Smith 1979). Because of the lack of well-defined differences, Hesler & Smith (1979) re-evaluated the status of *L. chelidonium* and treated it as a variety of *L. chelidonium*.

Microscopically, the most striking difference between Peck's collections of *L. chelidonium* var. *chelidonium* and the holotype of *L. chelidonium* var. *chelidonioides* is the ornamentation of the spores. The ornamentation is clearly higher in var. *chelidonioides* and forms a less complete network. In many spores the warts and short ridges are not organised in a reticulate pattern at all.

This variety seems to be collected more frequently than the type variety (e.g. Kuo 2003); the latter differs from var. *chelidonioides* by its mild taste, its indistinct smell and the latex that is bright yellow at first (becoming a pale tobacco to dirty brown, Hesler

& Smith 1979). More detailed research is needed on both varieties of *L. chelidonium* to decide on their taxonomic status.

3.1. *Lactarius indigo* (Schwein.: Fr.) Fr., Epicr. Syst. Mycol.: 341 (1838)

var. *indigo*

Figs. 1, 5

= *Agaricus indigo* Schwein.: Fr., Schr. Nat. Ges. Leipzig 1: 87 (1822)

= *Lactifluus indigo* (Schwein.: Fr.) Kuntze, Revisio Generum Plantarum, Pars II: 857 (1891)

= *L. canadensis* Winder, Mushrooms Canada, addenda [24] (1871)

Excluded: *L. indigo* sensu Imazeki et al. (1988), Nagasawa (1998) and probably several other authors (= *L. subindigo*) (see also Nuytinck et al. 2006).

Type: not typified, described from North Carolina.

DESCRIPTION: Pileus 5–15 cm diam., convex-depressed becoming deeply infundibuliform, with an inrolled margin at first; surface smooth (but actually with a lot of very small scrobicules), slightly viscid, nearly azonate to clearly zonate, often with fine but clear zones near the margin; colour bright blue when fresh and moist, fading to greyish to almost white (21A2) with a silvery sheen; zones staying deeper blue (22A-C4/5). Lamellae slightly decurrent, with a small decurrent tooth, rather close, medium thick, sometimes forked near the stipe; colour bright indigo blue (21B5/6) or paler, sometimes appearing yellowish from the mature spores, staining green where bruised; edge entire, slightly paler. Stipe 2–8 × 1–2.5 cm, central to more rarely eccentric, cylindrical, equal or tapering downwards; surface smooth, viscid but soon dry, mostly scrobiculate; colour indigo blue but often much paler (23A2/3) and with a whitish top layer; scrobicules deep blue (22B/C4/5). Context firm, hollow in the stipe, whitish buff to yellowish in the stipe, when cut immediately indigo blue in almost the entire pileus surface and the margins of the stipe, becoming deep bluish green after 1 h (26E5); smell agreeable, quite strongly fruity; taste mild to very slightly acrid after some chewing. Latex not very abundant, bright to dark blue (19/20C/D8 to 23D/E7/8), slowly turning green on the context; taste mild. Spore deposit cream colour (3A3/4).

FeSO₄ no reaction, KOH yellowish to pale watery orange on the pileus cuticle, stipe context and stipe cuticle, dirty orange on the hymenium, gaic no reaction.

Spores (6.9) 7.0–7.7–8.1–8.9 (9.2) × 5.3–5.9–6.2–6.8 μm, subglobose to ellipsoid (Q = 1.19–1.28–1.34–1.45); ornamentation up to 0.5 μm high, of medium thick ridges and low warts, forming an incomplete reticulum; plage distally slightly amyloid. Basidia 37–53 × 7.3–10.5 μm, cylindrical to subclavate, 4-spored, sometimes containing oil-droplets; sterigmata 3–7 μm long. Pleuromacrocystidia very abundant near the edge, becoming scarcer further away, 30–62 × 4–8 μm, emergent, subfusiform with a moniliform apex, with a granular content, thin-walled. Pseudocystidia very abundant, 3–6 μm broad, tortuous, mostly not emergent, with a dark ochre content in KOH. Lamella edge sterile with scarce to very abundant cheilomacrocystidia; cheileptocystidia 8–25 × 3–6 μm, mostly subclavate, hyaline, thin-walled; cheilomacrocystidia 18–37 × 3–7.3 μm (up to 50 μm in some collections), subfusiform with a moniliform apex, emergent, with a granular content, thin-walled. Subhymenium composed of compactly arranged, short cells. Hymenophoral trama composed of irregularly interwoven hyphae; lactifers

numerous. Pileipellis an ixocutis, 70–200 μm thick, of strongly interwoven hyphae, 1–5 μm diam.; shrivelled and gelatinised hyphae scarce; near the surface slender and strongly tortuous hyphae sometimes present. Stipitipellis a cutis, 50–60 μm thick, of regularly shaped hyphae, (1) 3–6 μm diam., lactifers present close to the surface. Clamp-connections absent.

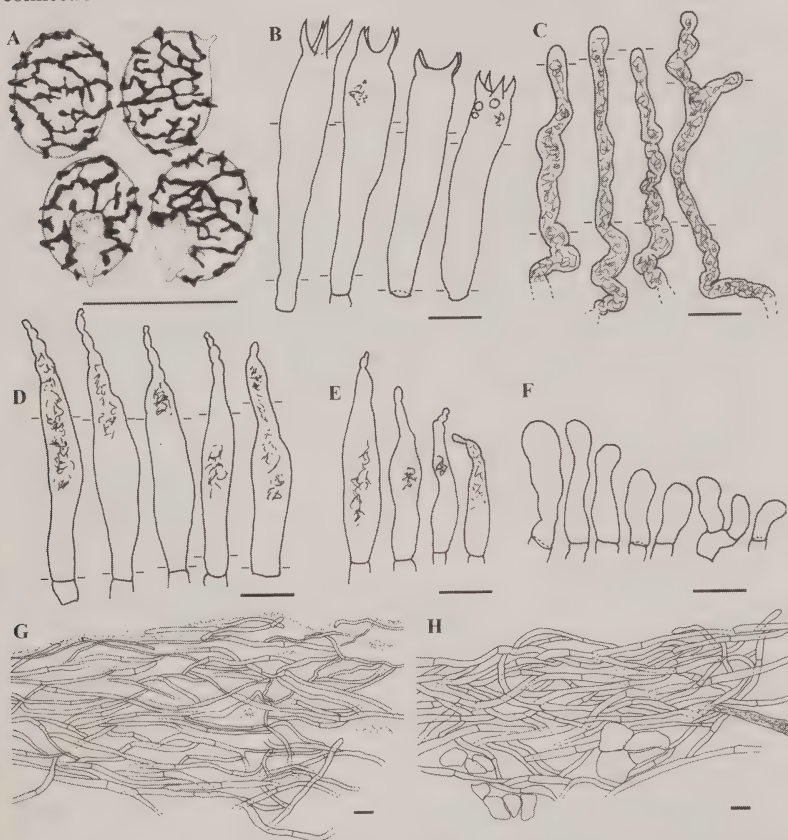


Fig. 5: *Lactarius indigo* var. *indigo*: A. spores; B. basidia; C. pseudocystidia; D. pleuromacrocyttidia; E. cheilomacrocyttidia; F. cheiloleptocystidia; G. section through the pileipellis; H. section through the stipitipellis. From B. Buyck 01.158, B. Kropp 29-Oct.-00-15, R.E. Halling 8143, R.F. Cain 24421 and S.L. Miller 9579. Scale bars = 10 μm , small bars indicate the height of the hymenium.

HABITAT: Scattered to gregarious on soil, in both *Pinus* and *Quercus* woods.

DISTRIBUTION: Not particularly common but fairly widespread in its distribution, found throughout eastern North America, southwards to southern Colombia (R. Halling pers. comm.).

COLLECTIONS EXAMINED: Belize, Mtn. Pire Ridge, Cayo district, *Pinus caribaea*, 29.10.2000, B. Kropp 29-Oct.-00-15 (RMS) – Cayo district, 03.08.2003, B. Kropp 3-Aug.-03-1 (RMS) – Costa Rica, B. Buyck 01.158 (PC) – Coto Brus, Las Mellizas, Zona Protectora Las Tablas, Finca La Cafrosa, Camino a Portones por El Tajo, *Quercus seemannii* & *Quercus* spp., scattered, on soil, 1475 m a.s.l., N8°55.034' W82°46.000', 07.06.2001, R.E. Halling 8143 (NY) – USA, R.F. Cain 24421 (ZT) – unknown, brought, West Virginia Mycological Association Foray in Green Briar State Forest, 09.09.1997, S.L. Miller 9579 (RMS) – Tennessee, Cocke Co., Greenbrier biological station (Tudor road), under Red Oak sp. and *Pinus* sp., 488 m a.s.l., N35°44.038' W083°25.45', 12.07.2004, J. Nuytinck 2004-002 (GENT).

DISCUSSION: Without a doubt, this is one of the most striking agarics seen anywhere. It is an unmistakable species, but Hesler & Smith (1979) warn not to confuse dried out specimens with *L. paradoxus*. This species shows quite some variability in colour (from young to old specimens) and in the placement of the stipe that can be eccentric (Hesler & Smith 1979). The macroscopical description given here is compiled from our own observations, Hesler & Smith (1979) and Kong Luz (1995).

At the very base of the stipe a whitish orange mycelium can be observed, that scarcely exudes a reddish orange latex (7A7/8 to 8C8); pale reddish orange coloured rhizomorphs can also be present at the base of the stipe (Kong Luz 1995, P. Leacock pers. comm.).

Found throughout eastern North America, *L. indigo* is distributed south to southern Colombia where it is associated with *Quercus humboldtii*. Tree partners in Costa Rica include *Q. seemannii*, *Q. copeyensis*, *Q. oocarpa*, *Q. oleoides*, *Q. corrugata* and *Q. costaricensis* (R. Halling pers. comm.). *Lactarius indigo* tends to be associated with *Pinus* in the northern part of its distribution area but with *Quercus* when moving southwards (B. Buyck pers. comm.). Records of *L. indigo* associated with *Pinus* are nonetheless known from Mexico (Kong Luz 1995).

There is a form (or perhaps a distinct taxon), found near Palo Verde in the northern Talamancas, that has narrow crowded lamellae, an azonate pileus and smaller stature (R. Halling pers. comm.). We had no material available for our phylogenetic analysis.

Microscopically the small spores are characteristic. This character state is shared with the very similar but not very closely related *L. subindigo* Verbeken & E. Horak, known from SE Asia to India (Verbeken & Horak 2000, Nuytinck et al. 2006).

3.2. *Lactarius indigo* var. *diminutivus* Hesler & A.H. Sm.,

N. Amer. Species *Lactarius*: 69 (1979)

Fig. 6

Holotype: Hillhouse 249 (MICH!), USA: Texas, Brazoria County

DESCRIPTION: Pileus 3–5 cm broad at maturity, plano-depressed becoming broadly infundibuliform, rarely remaining convex, margin inrolled at first; surface glabrous, viscid to slimy, when dry appearing unpolished (almost velvety); colour dark blue when young and fresh, grey-blue with a silvery sheen when dry, in age grey-green to olive green overall; margin often finely striate when moist, subzonate (zones visible at maturity only). Lamellae decurrent to longly decurrent, fairly broad, concolorous with the pileus, quickly staining dark indigo where cut or bruised and then slowly turning to grey-green or olive, green in age. Stipe 1.5–2.5 × 0.5–0.8 cm, solid, soon becoming hollow, tapering downwards, concolorous with the pileus. Context white but quickly

changing to dark blue by the abundant latex, changing to green in ± 0.5 h. Latex deep indigo blue, unchanging. Spore deposit white in a thin deposit.

Spores $7.0\text{--}7.5\text{--}7.6\text{--}8.2 \times 5.5\text{--}5.9\text{--}6.0\text{--}6.4$ μm , broadly ellipsoid ($Q = 1.18\text{--}1.26\text{--}1.29\text{--}1.34$); ornamentation up to 0.5 μm high, of (rather) thick ridges, rarely intermixed with finer ridges, with some small isolated warts, forming an almost complete reticulum; plage distally very slightly amyloid. Basidia $40\text{--}55 \times 7\text{--}10$ μm , subclavate to almost cylindrical, 4-spored, sometimes containing oil-droplets; sterigmata $3\text{--}6$ μm long. Pleuromacrocystidia apparently absent. Pseudocystidia rather abundant, $2.5\text{--}5.5$ μm broad, tortuous to cylindrical, sometimes branching, oleiferic, ochre-brown in KOH. Lamella edge often fertile, with scarce cheilomacrocystidia; cheileleptocystidia $9\text{--}30 \times 2.7\text{--}7$ μm , subclavate, sometimes containing oil-droplets, thin-walled; cheilomacrocystidia $28\text{--}45 \times 5.5\text{--}7$ μm , emergent, subfusiform with a capitate to moniliform apex, with a needle-shaped content, thin-walled. Subhymenium composed of subglobose cells, often arranged in rows. Hymenophoral trama irregular, with (short) hyphae and abundant, conspicuous lactifers. Pileipellis an ixocutis, $150\text{--}250$ μm thick, slime layer thin, few shrivelled or gelatinised hyphae; lactifers rather abundant and often situated close to the surface. Stipitipellis a thin ixocutis of hyaline narrow hyphae but no slime zone extending beyond the hyphal zone (surface lubricous to subviscid in wet weather). Clamp-connections absent.

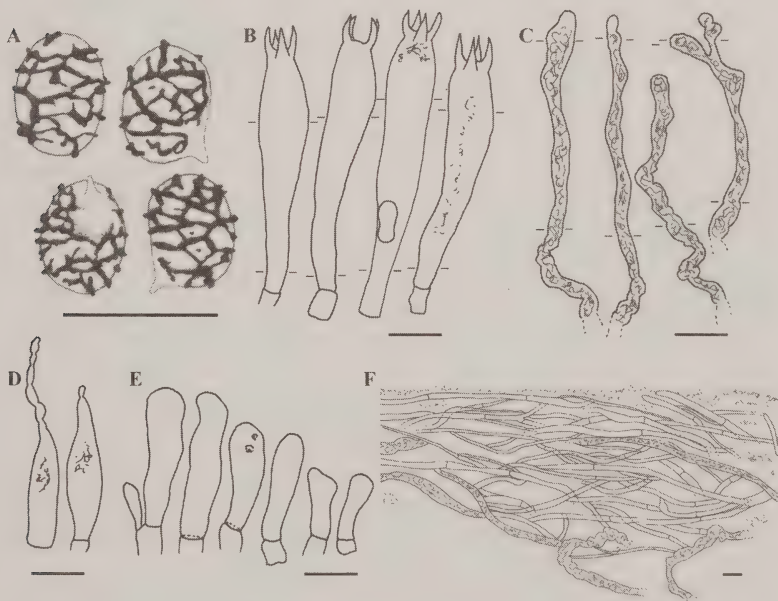


Fig. 6: *Lactarius indigo* var. *diminutivus*: A. spores; B. basidia; C. pseudocystidia; D. cheilomacrocystidia; E. cheileleptocystidia; F. section through the pileipellis. From E. Hillhouse 249 (type) and M.C.Aime 811. Scale bars = 10 μm , small bars indicate the height of the hymenium.

HABITAT: Type locality: on bottomland along sides of a muddy ditch under grasses and weeds, loblolly pine (*Pinus taeda*) nearby; gregarious in tufts of 2–3 or scattered; December and January (generally abundant but never found in any other than low muddy spots, Hillhouse in Hesler & Smith 1979).

DISTRIBUTION: Described from Brazoria County, Texas, possibly also in Virginia.

COLLECTIONS EXAMINED: USA, Texas, Brazoria Co., Liverpool, along ditch bottom and sides of old pipeline crossing, 26.12.1970, E. Hillhouse 249 (MICH), holotype – Virginia, Montgomery Co., Pandapas Pond Rec. Area, Jefferson National Forest, gregarious in one spot in bottom of moist creek bed, mixed woods, 26.08.1999, M.C.Aime 811 (RMS).

DISCUSSION: *Lactarius indigo* var. *diminutivus* differs from var. *indigo* by its small size, the pronounced change to green of the pileus and stipe, the locally thicker spore ornamentation and the scarcer macrocystidia. A fertile lamella edge has only been observed in *L. indigo* var. *diminutivus*. More collections need to be thoroughly described macro- and microscopically to decide on the status of this taxon. We sequenced only one collection, collected in Virginia. It groups with the *L. indigo* var. *indigo* collections in the ITS trees but not in the *gpd* trees, indicating a possible genetic difference.

4. *Lactarius miniatosporus* Montoya & Band.-Muñoz, Mycotaxon 89: 48 (2004)

Fig. 7

Holotype: Montoya 3830 (XAL!), Mexico: Veracruz, Mpio. Xico.

DESCRIPTION (macroscopy after Montoya & Bandala 2004): Pileus 4–11 cm diam., convex to plano-convex, centrally depressed; margin incurved, tomentose when young, expanding and becoming glabrous and striate in age; surface viscid, azonate or with diffuse and vanishing zones; colour pinkish with pale reddish tinges to pale pinkish vinaceous (7A2–B3, 8A/B2), with dark pinkish vinaceous stains (8C/D5), fading to straw colour or yellowish white (4A2–5A2/3–B2–B4); margin remaining vinaceous pink or vinaceous red (10B–D8); centre yellowish white with pale pinkish tinges, irregularly staining blue-green (25D3–25E8). Lamellae adnate to subdecurrent, close to moderately subdistant, forked near the stipe; colour pinkish grey (7B3/4, 8B2/3) or vinaceous red when observed in mass; colour $\pm$ pale pinkish vinaceous (10C5) as seen singly, staining blue-green (25D3–25E8) when handled; cut areas staining vinaceous red by the latex. Stipe 1.5–7 $\times$ (0.8) 1–2 cm, cylindrical; surface smooth, dry, very rarely superficially spotted; colour dull pink (8A2–B3) to vinaceous pink (7B3–8A2–C4/5, 9B4–10B3) or at times vinaceous red (10C/D5), whitish and subtomentose at the apex, staining blue-green (25D3–E8). Context whitish, staining pink (5A2, 7/8A2) when exposed, especially towards the margin of both pileus and stipe, staining vinaceous red by the latex and staining blue-green (25D3–D4–E8) in all parts; smell mild or of chlorine; taste mild to faintly astringent. Latex vinaceous red (8C/B7, 9E7/8). Spore deposit pale yellowish brown.

Spores 7.0–7.5–8.1 (8.2) $\times$ 5.5–5.8–6.2 (6.3) μ m, broadly ellipsoid to ellipsoid ($Q = 1.21\text{--}1.30\text{--}1.41$); ornamentation up to 0.5 μ m high, composed of medium thick ridges and some isolated warts, forming a rather complete reticulum; plage distally slightly amyloid. Basidia 36–70 $\times$ 8–10 μ m, subclavate, mostly 4-spored, often containing oil-droplets or with a granular content; sterigmata 4–5.5 μ m long. Pleuromacrocystidia

absent. Pseudocystidia abundant, 2–5.5 μm diam., often slightly emergent, tortuous and often branching, with an ochre-yellow content. Lamella edge sterile with rather scarce to moderately abundant cheilomacrocystidia; cheileptocystidia 8–30 $\times$ 2.6–8 μm , subclavate to irregularly shaped, hyaline, thin-walled; cheilomacrocystidia 28–46 $\times$ 5.3–9 μm , subfusiform with a moniliform apex, emergent, with a needle-shaped to granular content, thin-walled. Subhymenium composed of irregular to subglobose cells, sometimes arranged in short rows. Hymenophoral trama irregularly filamentous; with very abundant lactifers. Pileipellis an ixocutis, up to 250 μm thick, composed of strongly interwoven hyphae, 1–5 μm diam.; shrivelled and gelatinised hyphae abundant near the surface. Stipitipellis a cutis, up to 100 μm thick, composed of strongly interwoven, regularly shaped hyphae, 2–5 μm diam.; no shrivelled hyphae. Clamp-connections absent.

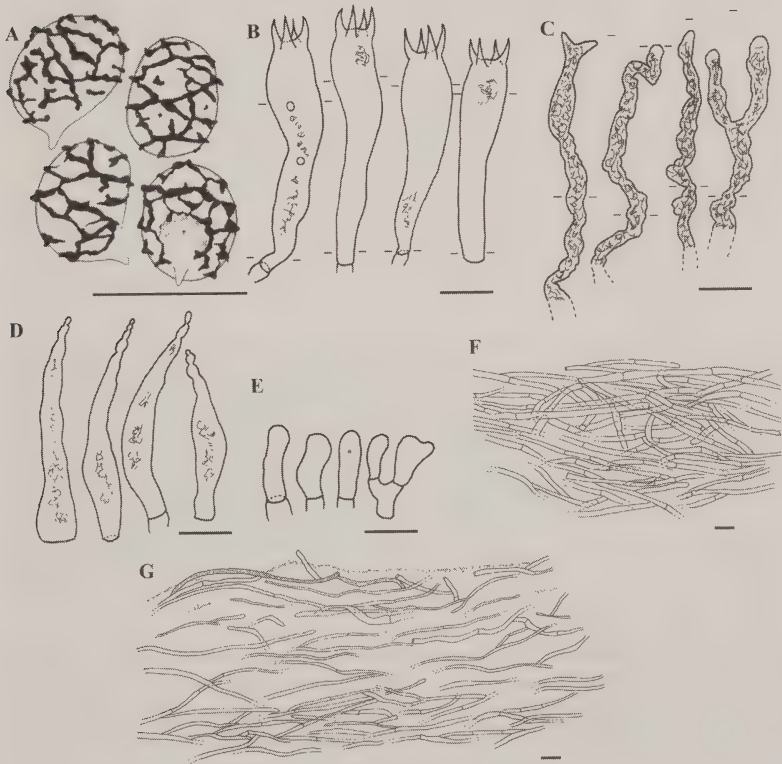


Fig. 7: *Lactarius miniatosporus*: A. spores; B. basidia; C. pseudocystidia; D. cheilomacrocystidia; E. cheileptocystidia; F. section through the stipitipellis; G. section through the hymenium. From Montoya 3830 (type). Scale bars = 10 μm , small bars indicate the height of the hymenium.

HABITAT: Associated with *Pinus* (type locality: in pure or mixed stands of *Pinus nubicola*, *P. pseudostrobus* and *P. patula*).

DISTRIBUTION: Known from the central region of the Gulf area of Mexico only.

COLLECTIONS EXAMINED: Mexico, Veracruz, Mpio. Xico, E Cofre Perote, Ejido Ingenio El Rosario, El Revolcadero, 2850 m a.s.l., under *Pinus patula*, 3.07.2002, Montoya 3830 (XAL), holotype.

DISCUSSION: *Lactarius miniatosporus* is a medium sized to quite large species, characterised by its pinkish pileus, soon fading to yellowish white, its red latex and its small spores.

Montoya & Bandala (2004) suppose a close relationship with *L. subpurpureus*, *L. thakalorum* and *L. sanguifluus*/*L. vinosus*, four species with vinaceous red latex and reddish tones in the basidiocarps. *Lactarius miniatosporus* differs from these species by its smaller spores and the absence of pleuromacrocyttidia. Characteristic for *L. miniatosporus* is the tendency of the pileus colour to become duller in age (the colour becomes straw colour to yellowish white, the vinaceous pigmentation is only observed at the margin). Our molecular analyses reveal a well-supported, close relationship of *L. miniatosporus* with *L. paradoxus*. Branch lengths are very short for these taxa in the ITS trees but clearly longer in the *gpd* trees. Only one specimen was included for both *L. miniatosporus* and *L. paradoxus* and thus results need to be interpreted with care.

5. *Lactarius paradoxus* Beardslee & Burl., Mycologia 32: 584 (1940)

Figs. 1, 8

Lectotype: Burlingham, 16-11-1939 (NY!), USA: Florida, Fort Christmas Land Development Co., hammock at "Old Faithful", near Fort Christmas (designated in Hesler & Smith 1979).

DESCRIPTION: Pileus 4.3–8 cm diam., broadly convex, becoming centrally depressed, in age finally infundibuliform; margin inrolled at first, thin and even, translucently striate; surface glabrous, viscid when wet, with concentric canescent zones, becoming more conspicuous when dry; colour greyish indigo to deep blue (20D/E3), paler between the zones, at first with an overall silvery shade, fading to pale blue in age, with yellowish straw stains (3/4A3), staining green when bruised; margin initially vinaceous (11B3/4), becoming reddish vinaceous to pinkish vinaceous (9D5/6) when mature. Lamellae adnate to decurrent, close, narrow, becoming broad, some forked near the stipe; colour pinkish vinaceous (8B3), often with salmon to ochraceous (6A2-B3) or vinaceous salmon (7/8A3) tinges, green (25E5/6) where bruised. Stipe 2–3.5 × 1–2 cm, subcylindric to attenuate near the base, sometimes tapering downwards to a root-like extension; surface dry, superficially scrobiculate, rugose to fibrose; colour pinkish vinaceous (9C4-D5) to vinaceous (10B/C4-12B4), often with bluish shades, with a dingy vinaceous apex at the line of gill attachment and pruinose below this, staining green (25E7) in age and where bruised; base with whitish rhizomorphs. Context thick and firm, becoming hollow in the stipe; colour pallid with a pink to green tinge, vinaceous and staining blue near the pileipellis, dark vinaceous near the stipitipellis, slowly becoming greenish where bruised; smell none; taste mild or slowly peppery to slightly acrid and only slightly bitter. Latex scarce, dark vinaceous brown to blood red (9E7/8), in age staining green on the context. Spore deposit yellow-ochre (5B5/6).

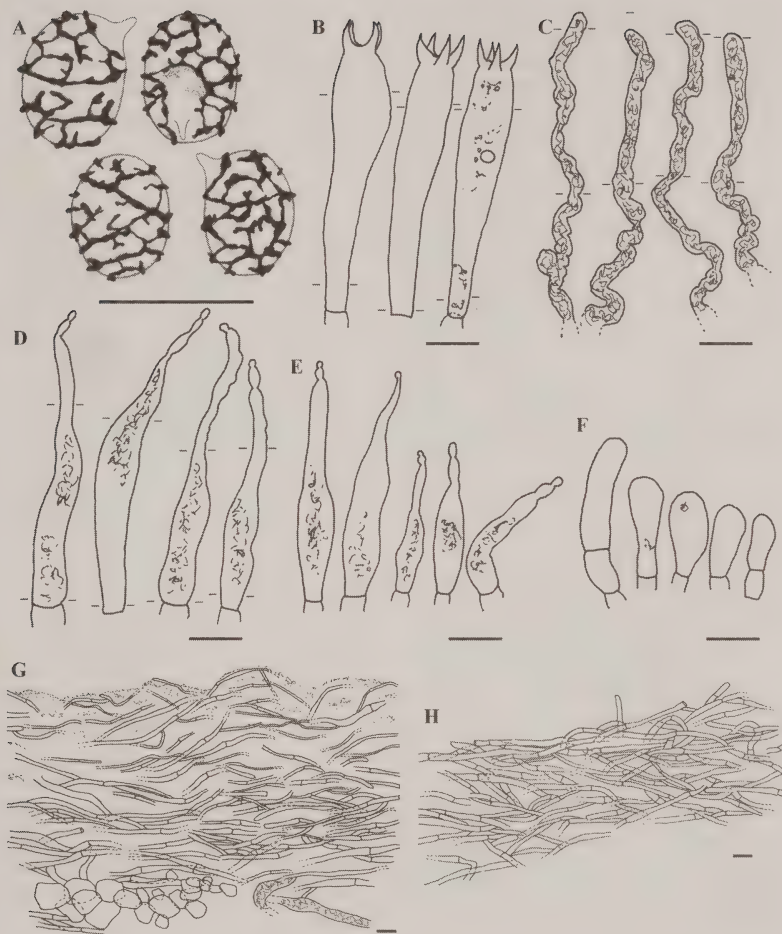


Fig. 8: *Lactarius paradoxus*: A. spores; B. basidia; C. pseudocystidia; D. pleuromacrocystidia; E. cheilomacrocystidia; F. cheileptocystidia; G. section through the pileipellis; H. section through the stiptipellis. From G.S. Burlingham 184233 (lectotype), G.S. Burlingham 184263 and D. Mitchell 01.02.2002. Scale bars = 10 μ m, small bars indicate the height of the hymenium.

KOH no reaction.

Spores $7.8-8.5-8.6-9.3 \times 5.8-6.2-6.3-6.7$ (6.9) μ m, broadly ellipsoid to ellipsoid ($Q = 1.23-1.36-1.38-1.46$); ornamentation up to 0.5 μ m high, of rather thick ridges, forming an almost complete reticulum, isolated warts scarce; plage distally slightly

amyloid. Basidia $47\text{--}54 \times 8\text{--}11\text{ }\mu\text{m}$, subclavate to cylindrical, 4-spored, often containing oil-droplets or needle-shaped crystals; sterigmata $3\text{--}6\text{ }\mu\text{m}$ long. Pleuromacrocystidia rather scarce to abundant, $37\text{--}76 \times 5.3\text{--}8\text{ }\mu\text{m}$, emergent, subfusiform, with a narrowing to strongly moniliform apex, sometimes with a granular, ochre-coloured content, thin-walled. Pseudocystidia abundant, $2\text{--}4\text{ }\mu\text{m}$ broad, slender, mostly not emergent, cylindrical to tortuous, with an oleiferic, ochre content. Lamella edge sterile with rather scarce to abundant cheilomacrocystidia; cheileptocystidia $10\text{--}23 \times 4\text{--}8\text{ }\mu\text{m}$, subclavate or more irregular, hyaline, thin-walled; cheilomacrocystidia $25\text{--}50 \times 3.3\text{--}8\text{ }\mu\text{m}$, emergent, subfusiform with a moniliform apex, often with a granular content, thin-walled. Subhymenium composed of small, globose to irregular cells, often in short rows. Hymenophoral trama composed of strongly interwoven hyphae; with abundant lactifers. Pileipellis an ixocutis, up to $200\text{ }\mu\text{m}$ thick, of strongly interwoven hyphae, $1\text{--}4\text{ }\mu\text{m}$ diam.; shrivelled hyphae abundant near the surface. Stipitipellis a cutis, up to $100\text{ }\mu\text{m}$ thick, of regular, strongly interwoven hyphae, $2\text{--}5\text{ }\mu\text{m}$ thick; shrivelled hyphae absent. Clamp-connections absent.

HABITAT: Scattered on sandy soil or in lawns; reported under *Quercus virginiana*, *Pinus banksiana*, *P. pseudostrobus*, *P. caribaea* and other *Pinus* spp.; found in the late summer and fall (August to September in the north, October to February in the south).

DISTRIBUTION: Known from the eastern USA (Florida, Michigan, Tennessee, Alabama, Mississippi, Texas and New York), southeast Canada (Ontario), Mexico and Cuba (Montoya et al. 1998).

COLLECTIONS EXAMINED: USA, Florida, Old Faithful, under cabbage palmetto and live oaks in grass, 16.11.1939, G.S. Burlingham 184233 (NY), lectotype – Florida, 20.11.1939, G.S. Burlingham 184263 (NY), labelled as co-type, possible syntype – Florida, Gulf County, Port St. Joe, Port St. Joe Historical cemetery, 01.02.2002, D. Mitchell (RMS).

DISCUSSION: *Lactarius paradoxus* is a medium sized species, characterised by the bluish and often greenish tinges in the pileus and the vinaceous red to brown latex. Remarkable is the short root-like projection of the stipe that is often present. The macroscopical description given here was compiled from the original description, from Hesler & Smith (1979) and from Montoya et al. (1998). Quite some variability in microscopical characters was found in this species. Hesler & Smith (1979) report several collections with differently ornamented spores. A remarkable variability in the abundance of macrocystidia was observed by us (even between the two collections made by Burlingham); Montoya et al. (1998) report the pleuromacrocystidia to be absent.

6.1. *Lactarius pseudodeliciosus* Beardslee & Burl., Mycologia 32: 582 (1940)

var. *pseudodeliciosus*

Figs. 1, 9

Lectotype: Beardslee & Burlingham 22-12-1937 (NY!), USA: Florida, Orange Co., Rock Springs, Kelly Park (designated in Hesler & Smith 1979).

DESCRIPTION (macroscopy after Beardslee & Burlingham 1940): Pileus $6\text{--}8.5\text{ cm}$ diam., broadly convex, deeply umbilicate, expanding to infundibuliform, margin thin agglutinated-fibrous when young (under a lens); surface very viscid when wet, azonate to faintly zonate; colour nearly white at first, becoming yellowish with age, centrally

pale pinkish buff to ochraceous-buff. Lamellae adnate to adnate-decurrent, intervenose; colour honey yellow as seen singly (except at the base, which is orange), with orange tones as seen in position. Stipe 1.2–2.5 × 1–2 cm, short, solid, extending to a root-like point on one side, somewhat scrobiculate; colour isabelline (dirty whitish), white-tomentose on the lower half. Context turning drab-green where bruised; smell none. Latex scanty, neutral orange; taste slowly peppery. Spore deposit ochraceous.

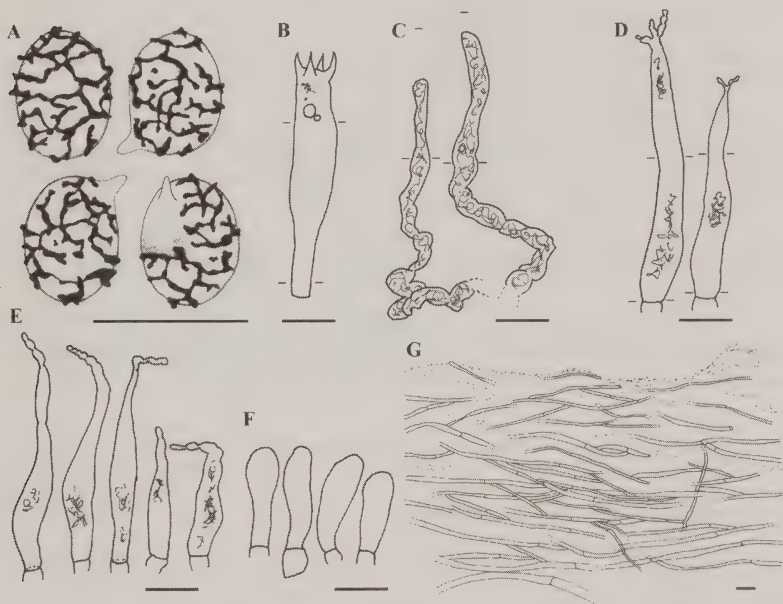


Fig. 9: *Lactarius pseudodeliciosus* var. *pseudodeliciosus*: A. spores; B. basidium; C. pseudocystidia; D. pleuromacrocystidia; E. cheilomacrocystidia; F. cheileleptocystidia; G. section through the pileipellis. From Beardslee & Burlingham 22.12.1937 (lectotype).

Scale bars = 10 μ m, small bars indicate the height of the hymenium.

Spores 7.9–8.4–8.9 × 5.8–6.3–6.7 μ m, broadly ellipsoid to ellipsoid ($Q = 1.27$ –1.34–1.43); ornamentation up to 0.5 μ m high, composed of mainly medium thick ridges with some thinner ridges and isolated warts, forming an incomplete reticulum; plage distally slightly amyloid. Basidia 35–45 × 6–9 μ m, subclavate, 4-spored, with oil-droplets or a granular content; sterigmata 4–6 μ m long. Pleuromacrocystidia not very abundant and often inconspicuous, 45–65 × 5–8 μ m, subfusiform with a moniliform apex, sometimes branching, with a needle-shaped content, thin-walled. Pseudocystidia abundant, cylindrical to tortuous, usually not emergent, with a yellow-ochre content. Lamella edge sterile with abundant cheilomacrocystidia on the edge or close to the edge; cheileleptocystidia 13–25 × 4–7 μ m, mostly subclavate, some irregular, hyaline,

thin-walled; cheilomacrocytidia $26\text{--}47 \times 3.5\text{--}8 \mu\text{m}$, emergent, subfusiform with a moniliform apex, with a needle-shaped content, thin-walled. Subhymenium composed of small, irregular cells. Hymenophoral trama with rather abundant, pale ochre coloured lactifers. Pileipellis an ixocutis, $150\text{--}300 \mu\text{m}$ thick, with abundant shrivelled and some gelatinised hyphae, $1\text{--}4 \mu\text{m}$ diam. Stipitipellis a cutis, of rather narrow hyphae. Clamp-connections absent.

HABITAT: Under *Quercus* and *Pinus*, November to February.

DISTRIBUTION: Only known from Florida.

COLLECTIONS EXAMINED: USA, Florida, Orange County, Rock Springs, Wood road, laurel wood, oak & pine, sand, 22.12.1937, Beardslee & Burlingham (NY), lectotype.

DISCUSSION: This rather badly known and apparently uncommon species seems to be characterised by the general pale colours of the pileus and stipe, the orange latex and the development of greenish stains upon bruising. Beardslee & Burlingham (1940) mention that *L. pseudodeliciosus* differs from "*L. deliciosus*" by the agglutinated fibrous edge as seen with a lens, the nearly white and usually azonate pileus and the lack of odour. Microscopical differences we observed are the smaller spores that are ornamented with thinner ridges.

The specimen included in the phylogenetic analyses (from which only the ITS sequence was obtained) shows that *L. pseudodeliciosus* clusters with *L. salmoneus*. Both species are on very long branches, indicating a high divergence.

6.2. *Lactarius pseudodeliciosus* var. *paradoxiformis* (Murrill) Hesler & A.H. Sm., N. Amer. Species Lactarius: 82 (1979) Fig. 10

= *L. paradoxiformis* Murrill, Lloydia 7: 304 (1945)

Holotype: Murrill, F19250 (FLAS!), USA: Florida, Marion Co., South of Orange Lake, Cherry Hill

DESCRIPTION (macroscopy after Murrill 1945): Pileus 6–8 cm diam., convex to applanate with a depressed centre; margin deflexed, even or striate over the lamellae, entire to undulate, paler; surface viscid, smooth, glabrous, cream-coloured, becoming in part or totally bluish green. Lamellae short-decurrent, arcuate, crowded or sub-crowded, rather narrow; colour ochraceous, becoming bluish green with age in places; edge entire. Stipe $2\text{--}5 \times 1\text{--}1.5 \text{ cm}$, equal; surface smooth, glabrous; colour ochraceous, bluish green where bruised. Context pallid above, ferruginous below, unchanging, slightly fragrant, slightly but distinctly acrid. Latex not copious enough to form drops but stains orange to rusty. Spore deposit ochroleucous.

Spores $7.7\text{--}8.4\text{--}9.1 (9.2) \times 5.7\text{--}6.2\text{--}6.7 \mu\text{m}$, broadly ellipsoid to ellipsoid ($Q = 1.25\text{--}1.35\text{--}1.43$); ornamentation up to $0.5 \mu\text{m}$ high, of medium thick to thin ridges and isolated warts, forming an incomplete reticulum; plage distally slightly amyloid. Basidia $35\text{--}52 \times 8\text{--}11 \mu\text{m}$, subclavate, 4-spored, often with oil-droplets or a granular content. Pleuromacrocytidia not very abundant, inconspicuous, $36\text{--}50 \times 5.5\text{--}7 \mu\text{m}$, subfusiform with a moniliform apex, with a granular content, thin-walled. Pseudocystidia scattered, $2\text{--}5 \mu\text{m}$ diam., not emergent, tortuous. Lamella edge sterile with rather abundant

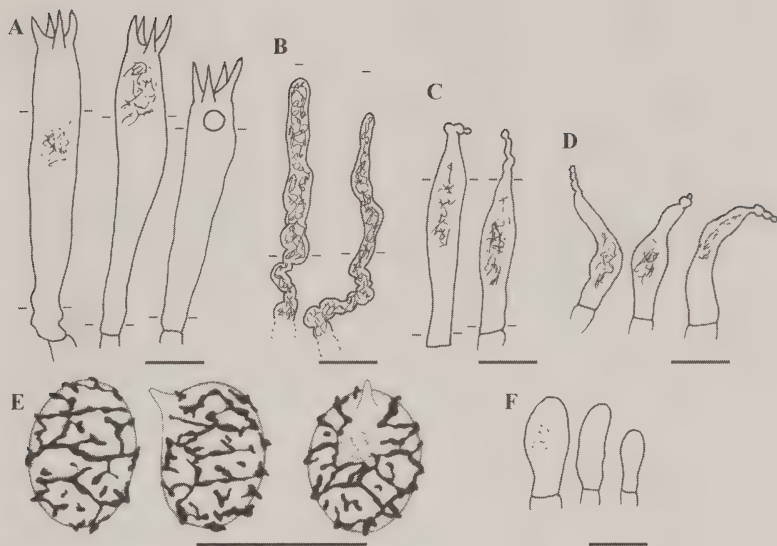


Fig. 10: *Lactarius pseudodeliciosus* var. *paradoxiformis*: A. basidia; B. pseudocystidia; C. pleuromacrocystidia; D. cheilomacrocystidia; E. spores; F. cheileptocystidia. From Murrill F19250 (type). Scale bars = 10 μ m, small bars indicate the height of the hymenium.

cheilomacrocystidia; cheileptocystidia 10–20 $\times$ 4–8.6 μ m, subclavate to irregular, hyaline, thin-walled; cheilomacrocystidia 18–30 $\times$ 3–5 μ m, emergent, subfusiform with a moniliform apex, often with a needle-shaped content, thin-walled. Pileipellis a thick ixocutis. Clamp-connections absent.

HABITAT: On the ground under hardwoods, especially red oak, fall to early winter (type locality).

DISTRIBUTION: Only known from Florida

COLLECTIONS EXAMINED: USA, Florida, Marion County, Cherry Hill, south of Orange Lake, Under red oak and hawthorn, 07.12.1941, Murrill F19250 (FLAS), holotype.

DISCUSSION: Hesler & Smith (1960) treated this taxon as a synonym of *L. pseudodeliciosus* but changed their mind in their later monograph of *Lactarius*. Their decision was based on the following differences in the original descriptions: *L. pseudodeliciosus* var. *paradoxiformis* has a striate pileus margin, a slightly fragrant smell and a distinctly acrid taste, while var. *pseudodeliciosus* has a thinly agglutinated fibrous edge, no distinct smell and a slowly, merely peppery taste. Another indicated difference is the lack of pleuromacrocystidia in *L. pseudodeliciosus* var. *paradoxiformis*, but we did observe (rather scarce and inconspicuous) pleuromacrocystidia in the type collection. Certainly

more collections need to be examined to draw any further conclusion about this taxon. We should remark here that the type collection is in a very bad state.

7. *Lactarius rubrilacteus* Hesler & A.H. Sm., N. Amer. Species *Lactarius*: 76 (1979)

Figs. 1, 11

Misapplication: *L. sanguifluus* sensu Hesler & Smith (1960).

Holotype: W.B. Gruber 1200 (MICH!), USA: Oregon, Grants Pass.

DESCRIPTION (macroscopy after Hesler & Smith 1979, Methven 1997): Pileus 4–15 cm diam., convex to applanate, depressed in the centre, becoming broadly infundibuliform with age; margin inrolled when young; surface glabrous, (sub)viscid, zonate, with light orange zones (5A2-4), alternating with brownish orange zones (6C5-7), developing irregular, dull green stains (26D3/4), generally duller and paler in age. Lamellae adnate to subdecurrent, close to crowded, narrow to moderately broad, forked near the stipe; colour light orange (6A2-4) to greyish orange (6B2-4), staining reddish brown (8D4-6) and then greyish green (25C6-8) when bruised, in age stained greenish; edge entire. Stipe 2.5–8 × 1–3 cm, equal to tapering downwards; surface glabrous to pruinose, dry, sometimes scrobiculate; colour light orange (6A3/4) to brownish orange (7C3/4) or greyish red (8C2/3); with a light orange (8C2/3) tomentum at the base. Context firm, brittle, thick, becoming hollow in the stipe; colour dingy yellowish white, staining reddish brown (8D4-6) when cut, staining greenish in age; smell becoming faintly subaromatic; taste mild. Latex scanty, in young specimens brownish red (8D4-6), often paler and dingy orange-red in mature specimens; taste not distinctive. Spore deposit pale yellow (4A2/3).

Spores 8.1–8.6–8.9–9.4 × 5.9–6.3–6.5–7.5 µm, broadly ellipsoid to ellipsoid (Q = 1.22–1.32–1.37–1.45); ornamentation up to 0.5 µm high, of thin to medium thick ridges and very abundant warts, forming a (very) incomplete reticulum; plage distinct but almost inamyloid. Basidia 43.5–56 × 8–10.5 µm, subcylindrical to subclavate, 4-spored, hyaline or containing small guttules, sometimes content granular; sterigmata 4–5 µm long. Pleuromacrocystidia rather abundant, especially close to the edge, 48–75 × 5.4–7 µm, emergent, subfusiform, with a moniliform apex, content granular or needle-shaped, thin-walled. Pseudocystidia rather abundant, 3.5–5.5 µm broad, mostly not emergent, cylindrical to tortuous, with a refractive, ochre content. Lamella edge sterile with very abundant cheilomacrocystidia; cheiloleptocystidia 14–30 × 3.4–6.7 µm, mostly subclavate, hyaline, thin-walled; cheilomacrocystidia 35–55 × 5–6 µm, emergent, subfusiform, with a moniliform apex, with a needle-shaped, refractive content, thin-walled. Subhymenium composed of irregular, small cells. Hymenophoral trama irregularly filamentous; with abundant, ochre coloured lactifers. Pileipellis a thick ixocutis, up to 350 µm thick, with an unclear slime-layer, hyphae (1) 3–8 µm diam.; shrivelled hyphae scarce, many hyphae orientated anticline to the surface. Stipitipellis a cutis, up to 80 µm thick, of strongly interwoven, regularly shaped hyphae, 2–5 µm diam. Clamp-connections absent.

HABITAT: Scattered to gregarious, often abundant, under Douglas fir (*Pseudotsuga menziesii*) and *Pinus* spp.

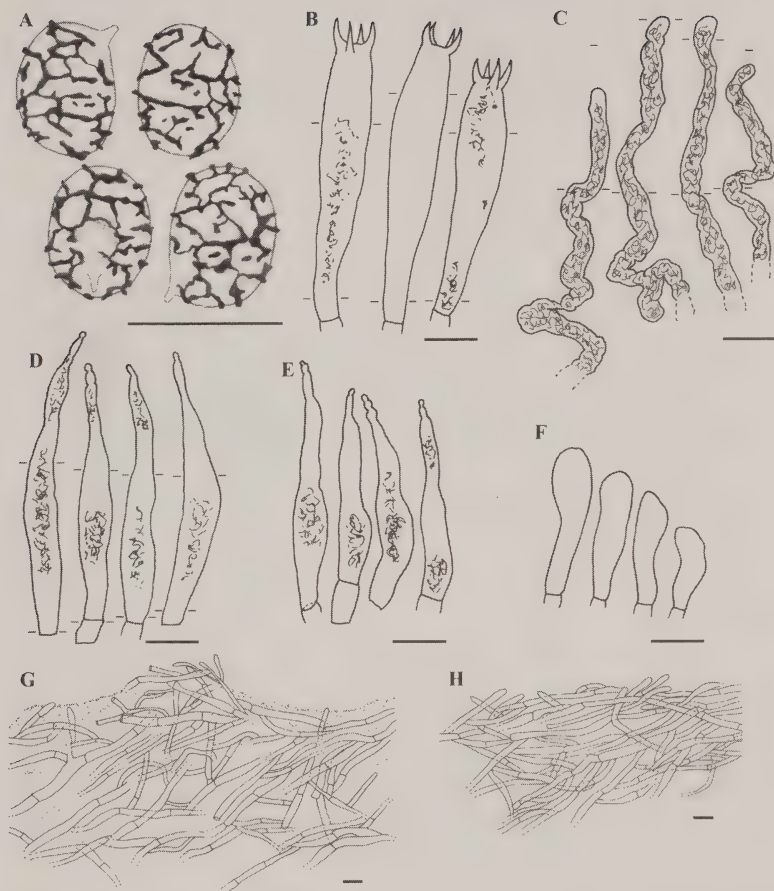


Fig. 11: *Lactarius rubrilacteus*: A. spores; B. basidia; C. pseudocystidia; D. pleuromacrocyistidia; E. cheilomacrocyistidia; F. cheileleptocystidia; G. section through the pileipellis; H. section through the stipeipellis. From W.B. Gruber 1200 (type), S.L. Miller 19-04, J. States AEF 1055 and A.S. Methven 485. Scale bars = 10 μ m, small bars indicate the height of the hymenium.

DISTRIBUTION: Occurring throughout the Pacific Northwest, south into California and in New Mexico, fruiting during the summer in the southern Rocky Mountains and in the fall in the Pacific Northwest (Hesler & Smith 1979).

COLLECTIONS EXAMINED: USA, Oregon, Josephine Co., Grants Pass, 17.11.1947, W.B. Gruber 1200 (MICH), holotype – California, Butte Co., Paradise, 2000 ft. a.s.l., 26.11.1968, D. Ripley 1626 (SFSU) – Arizona, Road between Big Lake & Alpine, Apache Natl. Forest, solitary in humus in mixed woods, 28.07.1972, H.D. Thiers 29827 (SFSU)

– Washington, Cispus Work Center near Randle, scattered in humus under Douglas fir, 20.10.1972, H.D. Thiers 30197 (SFSU) – California, Yuba Co., Bullard's Bar Reservoir, solitary to scattered in duff in mixed forest, 19.11.1981, H.D. Thiers, A.S. Methven 485 (SFSU) – California, Medocino Co., Jackson State Forest, "Suillus Park", gregarious in duff in mixed forest especially near *Pseudotsuga menziesii*, 6.11.1982, A.S. Methven 1912 (SFSU) – California, Santa Cruz Co., Hwy 9 near San Lorenzo Park, solitary in duff in hardwood-coniferous forest, 16.12.1982, H.D. Thiers, A.S. Methven 2360 (SFSU) – Washington, Kittitas Co., Stampede Pass Road, off I-90, East of Snoqualmie Pass, gregarious on moss and duff, under conifers, 9.10.1984, A.S. Methven 3444 (SFSU) – California, Sierra Co., Wild Plum campground, near Sierra City, solitary in soil under Douglas fir, 4.10.1989, H.D. Thiers 52786 (SFSU) – New Mexico, Hwy 64 between Taos and Angel Fire, in soil under mixed conifer hardwoods, 24.08.1991, E. Thiers & H.D. Thiers 53639 (SFSU) – Arizona, Coconino Co., Bismark Lake Trail, mixed conifer-*Populus*, 26.08.1992, J. States, AEF 947 (MICH) – California, Marin Co., Mt. Tamalpais watershed, Rock Springs area, Benstein Trail, collected under pure *Arctostaphylos glandulosa*, 22.12.1992, D.E. Desjardin 5595 (SFSU) – Arizona, Cochise Co., Onion Saddle, *Quercus* and *Pinus edulis*, 4.09.1993, J. States, AEF 1055 (MICH) – Arizona, Cochise Co., Onion Pass, *Pinus*, *Juniperus*, *Quercus* and *Pseudotsuga menziesii*, 4.09.1993, J. States, AEF 1060 (MICH) – California, 14.01.2004, S.L. Miller 11-04 (RMS) – California, 14.01.2004, S.L. Miller 19-04 (RMS).

DISCUSSION: *Lactarius rubrilacteus* is characterised by a zonate, brownish orange pileus and reddish brown latex (Methven 1997). Confusion with similar species, occurring in the same area, seems unlikely. It is reported under both *Pseudotsuga menziesii* and *Pinus* spp.; collection D.E. Desjardin 5595 (SFSU) was found in a pure *Arctostaphylos glandulosa* stand.

For years Hesler & Smith (1960, 1979) used the name *L. sanguifluus* for this species. After comparison with the plates of *L. sanguifluus* by Paulet (1811, plate 81, fig. 3–5) and Neuhoﬀ (1956, plate 6, fig. 24), they decided that the species depicted on these plates could not be reconciled with the "*L. sanguifluus*" from the western United States (Hesler & Smith 1979). Our phylogenetic analyses indeed confirm this and even place *L. sanguifluus* and *L. rubrilacteus* in very different clades. Interestingly, according to the phylogenetic analyses of both ITS and *gpd* genes, *L. rubrilacteus* is very closely related to *L. porninsis*, a European species with white latex, associated with *Larix*.

8. *Lactarius rubriviridis* Desjardin, H.M. Saylor & Thiers, Mycologia 95: 148 (2003)

Figs. 12, 14

Holotype: DED 7312 (SFSU!), USA: California, Sierra Co., Cold Creek Campground.

DESCRIPTION (macroscopy after Desjardin 2003): Basidiomes hypogeous, 2.5–6 cm long × 2–4.5 cm broad × 1.5–3 cm thick, irregularly globose to ovoid or ellipsoid, sometimes lobed. Peridium absent, exterior surface alveolate to ridged and pitted from exposed locules and hymenophoral tramal tissue; ridges reddish brown to dark brown (8/9E/F5–7), staining deep greenish grey to bluish green or dark green (25–27F5–7) where bruised. Gleba loculate; locules irregular in shape, often elongate, 1–5 mm × 0.5–1.5 mm, filled with yellowish white to orange-white (4/5A2) or cream-coloured (4A3) basidiospores at maturity; hymenophoral tramal tissue firm, waxy, white to yellowish white (4A2), but becoming reddish brown (9D7/8) when cut from exuded latex; columella rudimentary

to well-developed, composed of radiating dendritic veins arising from a central main vein, 1–4 mm diam., initially white, but staining greenish white (27A2/3) to greyish green (26C6/7) over time when cut. Latex scant, deep red (9B/C7/8), discolouring tramal tissue to dark brownish red (11/12E7/8). Odour not distinctive or sweet. Taste mild. Spores forcibly discharged, leaving an orange-white (5A2) to yellowish white (4A2) or cream (4A3) deposit.

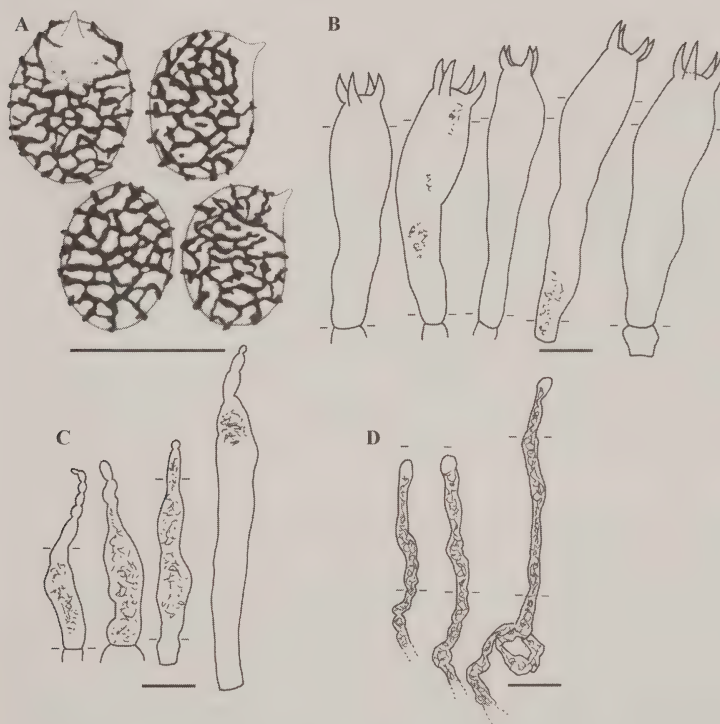


Fig. 12: *Lactarius rubriviridis*: A. spores; B. basidia; C. macrocystidia; D. pseudocystidia. From D.E. Desjardin 7312 (type). Scale bars = 10 μ m, small bars indicate the height of the hymenium.

Spores $8.0\text{--}8.9\text{--}9.2\text{--}10.8 \times 6.0\text{--}6.7\text{--}6.9\text{--}7.9$ μ m, broadly ellipsoid to ellipsoid ($Q = 1.26\text{--}1.33\text{--}1.34\text{--}1.43$), inequilateral in profile with an eccentric hilar appendix; ornamentation up to 0.5 μ m high, of dense, rather tick ridges, forming a complete reticulum with very small meshes, isolated warts rare; plage rather large but only weakly amyloid. Basidia $40\text{--}60 \times 10\text{--}12.7$ μ m, subclavate, 4-spored, sometimes with a granular content; sterigmata 3.3–6 μ m long. Macrocystidia rather scarce, $34\text{--}67 \times 4.3\text{--}8$ μ m, often hardly visible, rarely emergent, subfusiform with a moniliform apex, with a granular to needle-shaped content, thin-walled. Pseudocystidia rather abundant, 2–4 μ m

broad, slender and short, mostly not emergent, content oleiferic. Subhymenium of short-celled hyphae, not very well differentiated. Hymenophoral trama composed of densely compact, agglutinated hyphae, 3–10 μm diam., cylindrical to subglobose; lactifers abundant, contorted to strangulate, 3–5 (10) μm diam., refractive, yellowish orange in KOH. Columella tissues similar to the hymenophoral trama. Sphaerocytes absent in all tissues. Clamp-connections absent.

HABITAT: Buried under needle duff of conifers (*Abies* spp., *Pinus* spp.), June (type locality).

DISTRIBUTION: Only known from the Sierra Nevada, California.

COLLECTIONS EXAMINED: USA, California, Sierra Co., Highway 89, Cold Creek Campground, solitary, hypogeous under *Abies* and *Pinus* in montane conifer forest, 14.06.2001, D.E. Desjardin 7312 (SFSU), holotype.

DISCUSSION: Diagnostic features of *L. rubriviridis* are the gasteroid, hypogeous basidiome that lacks a peridium, the red latex, the green stains developing on the tissues, the well-developed dendritic columella and the reticulate ballistospores. The size and ornamentation of the spores are very similar in *L. rubriviridis* and its closest relative *L. barrowsii*. This is an extra indication that *L. rubriviridis* was recently derived from its epigeous, agaricoid ancestor *L. barrowsii*, that can be found in the same type of habitat.

Desjardin (2003) mentions that macrocystidia are absent in *L. rubriviridis*, while pseudocystidia are described as cylindrical with a tapered apex, projecting slightly beyond the basidia and hyaline or with orange globular contents. From this description we derive that macrocystidia were probably called pseudocystidia here and that pseudocystidia were overlooked.

9.1. *Lactarius salmoneus* Peck, Bull. Torrey Bot. Club 25: 369 (1898)

var. *salmoneus*

Fig. 13

Holotype: Earle & Baker (NYS!), USA: Alabama, Vaughn's Mills

DESCRIPTION (macroscopy after Peck 1898): Pileus 2.5–3.8 cm broad, rather thin, convex, becoming nearly applanate or slightly depressed in the centre; surface dry, subvelvety, sometimes irregular; colour white, becoming reddish where bruised. Lamellae adnate or decurrent, narrow, close; colour bright salmon colour. Stipe about 2.5 $\times$ 3–6 cm, short, solid, central or occasionally eccentric; surface velvety; colour white, salmon within. Context taste mild, slightly aromatic. Latex bright salmon coloured.

Spores 6.9–7.6–7.9–8.4 (8.5) $\times$ 5.1–5.1–5.6–6.1 μm , mostly ellipsoid, more rarely broadly ellipsoid ($Q = 1.30\text{--}1.34\text{--}1.41\text{--}1.47$); ornamentation 0.2–0.4 μm high, of medium thick ridges and some finer lines, forming an incomplete reticulum, isolated warts rather scarce; plage indistinct. Basidia 33–45 $\times$ 5.5–8 μm , mostly subcylindrical, 4-spored, often containing oil-droplets; sterigmata 3.5–6 μm long. Pleuromacrocystidia (very) scarce but locally abundant close to the edge, 35–60 $\times$ 5.5–8 μm , emergent, subfusiform with a moniliform apex, with a refractive, needle-shaped content, thin-walled. Pseudocystidia scarce, 2.5–4 μm broad, often emergent, mostly cylindrical, often branching, inconspicuous, with a pale yellow content. Lamella edge sometimes fertile, with scarce cheilomacrocystidia; cheiloleptocystidia 11–25 $\times$ 3.5–7 μm , subclavate to

irregular, hyaline, thin-walled; cheilomacrocystidia $17\text{--}24 \times 4\text{--}5.5\ \mu\text{m}$, subfusiform with a moniliform apex, with a needle-shaped content, thin-walled. Subhymenium composed of small, isodiametric cells. Hymenophoral trama composed of irregular, enlarged cells and abundant, yellow to ochre coloured lactifers. Pileipellis a cutis inclining towards a trichoderm locally, up to $200\ \mu\text{m}$ thick, of regularly shaped, strongly interwoven and frequently branched hyphae, $2\text{--}4\ \mu\text{m}$ diam., no shrivelled hyphae present; erect hyphae present at the surface, forming tufts. Stipitipellis a cutis, up to $70\ \mu\text{m}$ thick, of regularly shaped, strongly interwoven hyphae, $2\text{--}4\ \mu\text{m}$ diam. Clamp-connections absent.

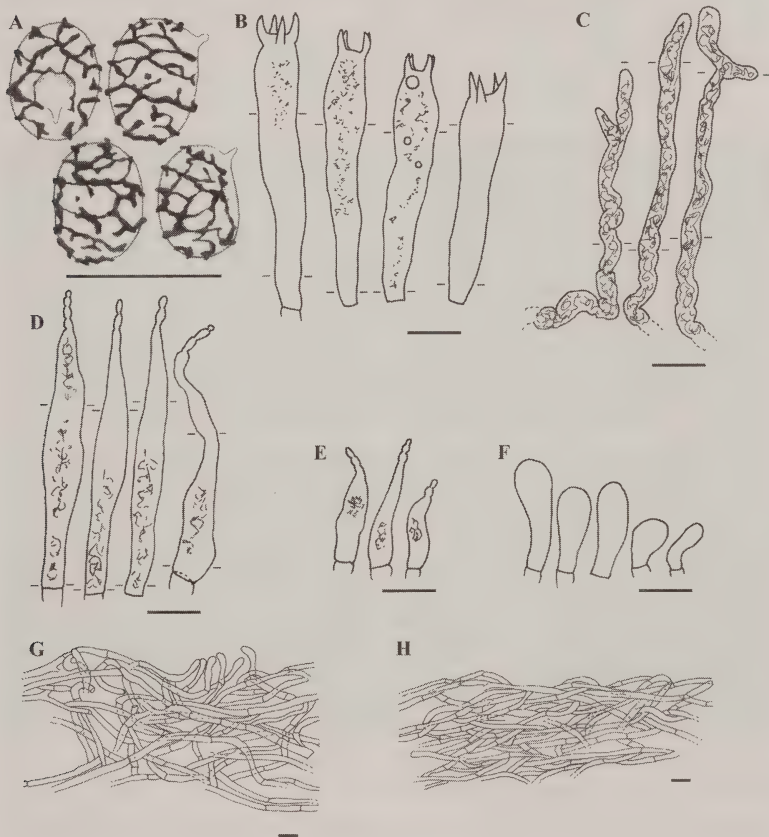


Fig. 13: *Lactarius salmoneus*: A. spores; B. basidia; C. pseudocystidia; D. pleuromacrocystidia; E. cheilomacrocystidia; F. cheileleptocystidia; G. section through the pileipellis; H. section through the stipitipellis. From Earle & Baker (type), B. Kropp 29-Oct.-00-3 and B. Kropp 11-Aug.-00-14.

Scale bars = $10\ \mu\text{m}$, small bars indicate the height of the hymenium.

HABITAT: In wet swampy places, usually on inundated ground, collected in August (Earle & Baker, type locality in Alabama); probably associated with *Pinus*.

DISTRIBUTION: Reported from Alabama, North Carolina and Tennessee, USA (Hesler & Smith 1979).

COLLECTIONS EXAMINED: USA, Alabama, Vaughn's Mills, in wet swampy places, usually on naked ground that has been overflowed, August, Earle & Baker (NYS), holotype.

DISCUSSION: Peck (1898) describes *L. salmoneus* as "a small but very distinct species easily recognized by the salmon colour of the milk and the change in the colour of the bruised flesh (turning reddish)". The spores are comparatively small. The white epicuticular covering of the pileus is the outstanding feature of both *L. salmoneus* var. *salmoneus* and var. *curtisii* (Hesler & Smith 1979). The inrolled margin is cottony but not as much as in *L. deceptivus* Peck. In both *L. salmoneus* var. *salmoneus* and var. *curtisii* anticline to ascending hyphae, single or in tufts are observed, but never forming a trichoderm. These elements become matted down in age and finally the layer is eroded. The layer is not distinct anatomically from the cuticular region of the pileus, but according to Hesler & Smith (1979) the entire region features very intricately interwoven, much-branched, relatively uninflated hyphae forming a layer quite unusual for the genus.

9.2. *Lactarius salmoneus* var. *curtisii* (Coker) Hesler & A.H. Sm.,

N. Amer. Species *Lactarius*: 72 (1979)

Figs. 13, 14

= *L. curtisii* Coker, J. Elisha Mitchell Sci. Soc. 34: 41 (1918)

Holotype: Coker 1845 (NCU), USA: North Carolina, hill southwest of Sparrow's Mill

DESCRIPTION (macroscopy after Montoya et al. 1996, Hesler & Smith 1979): Pileus 2–6 (9) cm diam., convex becoming broadly depressed, with an arched margin or the margin nearly applanate and depressed in the centre; margin inrolled and cottony; surface dry and felty (as if covered with a layer of cotton), not at all zonate; colour evenly white or with a cream orange shade (5A3) at first, in age staining bluish green where bruised. Lamellae subdecurrent, many forked at the base, narrow, close; colour cadmium orange to ochraceous salmon, readily staining green where injured, sometimes faded to whitish; edge whitish. Stipe 1–4 × 0.9–1.5 cm, equal or enlarged above; covered by a white, fine felt-like coating (similar to that of pileus) at first; colour cadmium orange. Context solid, whitish, in age pallid orange, staining cadmium orange when cut, discolouring green; smell and taste not distinctive. Latex scanty, cadmium orange when first exposed, unchanging but finally greenish (4C3–4B3) on the context; taste faintly peppery in young basidiocarps, mild at maturity. Spore deposit yellowish.

FeSO₄ pale blue on the context, phenol no reaction, NH₄OH no reaction, H₂SO₄ black on the context (Montoya & Bandala 1996).

Spores 6.9–7.6–7.8–8.7 × 4.7–5.1–5.3–6.4 µm, mostly ellipsoid, more rarely broadly ellipsoid, shape quite variable ($Q = 1.21\text{--}1.34\text{--}1.42\text{--}1.54$); ornamentation less than 0.5 µm high, of mainly rather broad, irregular ridges and some finer lines, forming an incomplete reticulum, isolated warts rather scarce; plage inconspicuous and small, distally slightly amyloid. Basidia 33–55 × 5.5–8 µm, slender, mostly (sub)cylindrical, 4-spored, with a granular content and often containing oil-droplets; sterigmata 3.5–6 µm long. Pleuromacrocyttidia (very) scarce but locally abundant close to the edge, 50–60 × 5.5–7.5 µm, emergent, subfusiform with a narrowing to moniliform apex,

with a refractive, needle-shaped content, thin-walled. Pseudocystidia scarce, 2.5–4.5 μm broad, often emergent, mostly cylindrical, often branching, inconspicuous, with a pale yellow content. Lamella edge sometimes fertile, with scarce cheilomacrocytidia; cheileptocystidia 10–22 $\times$ 3.5–7 μm , subclavate to irregular, hyaline, thin-walled; cheilomacrocytidia 17–25 $\times$ 4–5.5 μm , subfusiform with a moniliform apex, with a needle-shaped content, thin-walled. Subhymenium composed of small, isodiametric cells. Hymenophoral trama composed of irregularly arranged hyphae and abundant, yellow to ochre coloured lactifers. Pileipellis a cutis inclining towards a trichoderm locally, 120–150 μm thick, of regularly shaped, strongly interwoven and frequently branched hyphae, 2–4 μm diam., no shrivelled hyphae present; upright hyphae present at the surface, united into fascicles. Stipitipellis a cutis, 50–70 μm thick, of regularly shaped, strongly interwoven hyphae, 2–4 μm diam. Clamp-connections absent.

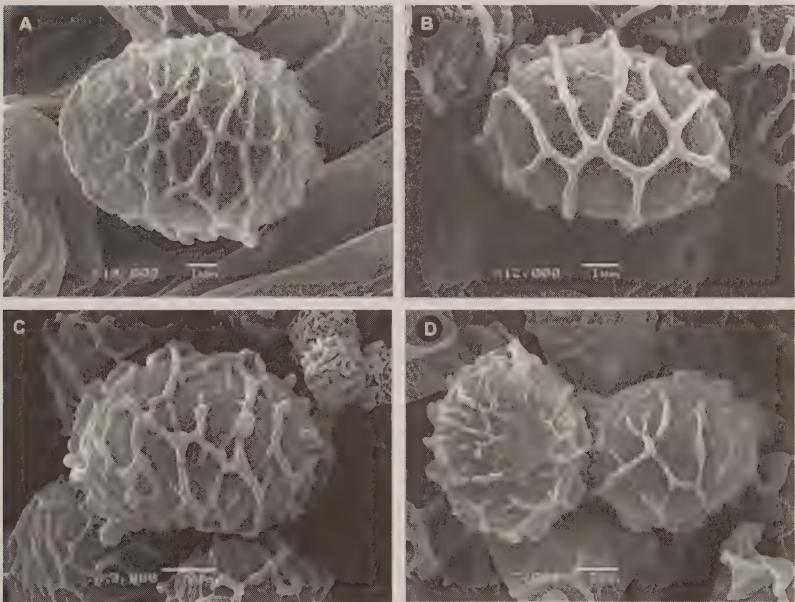


Fig. 14: SEM images of spores A. *L. rubriviridis* (D.E. Desjardin 7312, type); B. *L. salmonense* var. *curtisii* (B. Kropp 11-Aug.-00-14); C. *L. subpurpureus* (J. Nuytinck 2004-014); D. *L. thynos* (S.L. Miller 9648).

HABITAT: Moist areas of lower altitude, under *Pinus* spp.

DISTRIBUTION: Distributed throughout the pine belt of the southeast USA, also reported from Mexico (Cifuentes et al. 1989, Montoya et al. 1996) and Belize.

COLLECTIONS EXAMINED: Belize, Cayo district, Mtn. Pire Ridge, under *Pinus caribaea*, 29.10.2000, B. Kropp 29-Oct.-00-3 (RMS), notes: latex orange, greenish stain, cap whitish – USA, Mississippi, Harrison Co., Harrison Exp. forest, under *Pinus*, 11.08.2000,

B. Kropp 11-Aug.-00-14 (RMS), notes: latex orange, slowly staining greenish, det.:
Cibula B.

DISCUSSION: Hesler & Smith (1979), focussing on the diversity in the genus *Lactarius*, lowered *L. curtisii* to the rank of variety under *L. salmoneus* but admit there are few arguments to keep two different taxa. The only differences they report between both varieties are the lack of green discolouration and slightly larger spores in *L. salmoneus* var. *salmoneus*. Our request to see the holotype of *L. salmoneus* var. *curtisii* was never answered by NCU. The examined specimens from Belize and Mississippi showed a greenish staining reaction and were thus identified as *L. salmoneus* var. *curtisii*. It is very doubtful, that the distinction between both varieties can be maintained. The greenish discolouration in *Lactarius* sect. *Deliciosi* is often delayed, sometimes very faint and in some species sometimes erratic. Hesler & Smith (1979) expect that green staining will be found in the type variety of *L. salmoneus* when it becomes better known. Microscopical features are identical for both varieties. We were not able to study fresh collections from either variety of *L. salmoneus* and thus do not draw any further conclusions. As the microscopical features are identical drawings were united into one plate (Fig.13).

10. *Lactarius subpurpureus* Peck,

Rep. (Annual) New York State Mus. Nat. Hist. 29: 43 (1878)

Figs. 14, 15

= *Lactifluus subpurpureus* (Peck) Kuntze, Revisio Generum Plantarum, Pars II: 857 (1891)

Holotype: Peck (NYS!), USA: New York, Sandlake

DESCRIPTION: Pileus 4–10 cm diam., convex when young, becoming applanate when mature with a slightly depressed centre, never deeply infundibuliform; margins bent downwards to flattened, vaguely striate; surface smooth, viscid, zonate to scrobiculate; zones fading in age; colour pinkish to vinaceous buff (9B2/3), paler flesh-coloured to pink in the centre (10A2), but deep pink to brownish near the margin (10D4), hygrophanous, becoming very pale vinaceous pink (9A2) in the centre, margin staying deeper pink (9C4/5), green discolouration (28A2) never very extensive. Lamellae adnate to subdecurrent, sometimes with a small decurrent tooth, moderately broad and subdistant, rarely anastomosing; colour vinaceous buff to dirty pinkish or pale vinaceous red (9B2/3 to 10A/B4), turning slightly green when bruised; edge entire, ± concolorous. Stipe 3–8 × 0.7–1.5 cm, almost cylindrical or broader at the base, relatively long and slender; surface smooth, dry, tomentose at the base with whitish orange coloured subiculum sometimes present, with scarce to rather abundant, darker scrobicules; colour pinkish (10C3 to 11C2/3), covered with a whitish layer, almost white near the apex and the base, greenish discolouration mainly near the base. Context not very firm and rather thin, turning hollow in the stipe, whitish buff but yellowish to brown in the stipe cavity, staining vinaceous red (10E/F7) underneath the pilei- and stipitipellis and above the lamellae, ± unchanging, green where affected by parasites; smell sweetish and fruity, agreeable; taste mild becoming very slightly acrid. Latex scarce, vinaceous red (10D5), very dark brownish red (11F8) after 1 h on the context; taste mild. Spore deposit pale yellow-orange (4A3).

KOH no reaction, gaiac slowly turning blue on context.

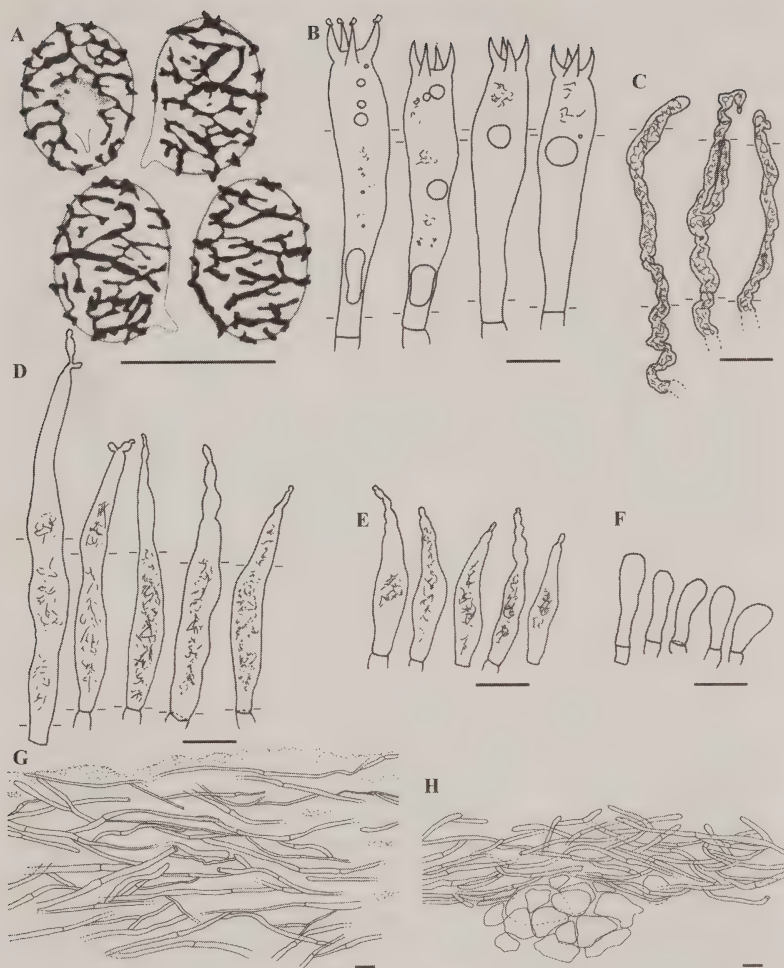


Fig. 15: *Lactarius subpurpureus*: A. spores; B. basidia; C. pseudocystidia; D. pleuromacrocytidia; E. cheilomacrocytidia; F. cheileptocystidia; G. section through the pileipellis; H. section through the stiptipellis. From C.H. Peck (type), J.R. Herr 348, J.R. Herr 574 and J. Nuytinck 2004-014.

Scale bars = 10 μ m, small bars indicate the height of the hymenium.

Spores 9.3–10.0–10.6–11.2 (12) $\times$ 6.8–7.1–7.3–7.7 μ m, ellipsoid ($Q = 1.30\text{--}1.38\text{--}1.45\text{--}1.52$); ornamentation up to 0.5 μ m high, of rather thick ridges mixed with finer interconnecting lines, some isolated warts present, forming an incomplete reticulum; plage distally slightly amyloid. Basidia 46–60 $\times$ 9–11 μ m, subclavate, 4-spored, rarely 2-spored, containing oil-droplets; sterigmata 4–6 μ m long. Pleuromacrocytidia abundant,

37–78 × 4.5–8 µm, emergent and very conspicuous, subfusiform with a tapering to moniliform, sometimes branching apex, with a needle-shaped content, thin-walled. Pseudocystidia abundant, 1.6–4 µm broad, rather slender, not to slightly emergent, mainly tortuous, sometimes branching, oleiferic, content deep ochre coloured. Lamella edge sterile with rather abundant to rather scarce cheilomacrocytidia; cheileptocystidia 12.5–18 × 4–6 µm, subclavate to irregular, hyaline, thin-walled; cheilomacrocytidia 25–33 × 3.4–6 µm, emergent, subfusiform, with a moniliform apex, with a needle-shaped to granular content, thin-walled. Subhymenium composed of densely interwoven hyphae, appearing like subglobose cells, mostly arranged in short rows. Hymenophoral trama of short hyphae, irregularly arranged; lactifers very abundant and conspicuous. Pileipellis an ixocutis, 70–150 µm thick, of strongly interwoven hyphae, 1–5 µm diam., shrivelled and gelatinised hyphae abundant. Stipitipellis a cutis to ixocutis, thin, up to 50 (70) µm thick, of strongly interwoven, regularly shaped hyphae, 2–4 µm diam. Clamp-connections absent.

HABITAT: On soil in coniferous and mixed woods, associated with hemlock (*Tsuga canadensis*), found in the summer and early fall (Hesler & Smith 1979).

DISTRIBUTION: Eastern half of the USA and southern Canada, south to the Gulf Coast region (Hesler & Smith 1979).

COLLECTIONS EXAMINED: USA, New York, Sandlake (& Brewerton), mossy ground in swamps, October, C.H. Peck (NYS), holotype – Virginia, Cherokee flats near interiors VA, in moist *Rhododendron* flat with hemlock and 2-needle pine, 21.08.1997, S.L. Miller 9572 (RMS) – Virginia, Poverty Creek Trail, Jeff. Nat. Forest, under hemlock, 09.03.1998, J.R. Herr 050 (RMS) – Virginia, Montgomery Co., Poverty Hollow, Jeff. Nat. Forest, Road 708, along trail through mixed hardwoods/conifers, 07.10.1999, J.R. Herr 491 (RMS) – Virginia, Giles Co., Cherokee Flats, Jeff. Nat. Forest, along trail through mixed hardwood/conifer forest, 09.10.1999, J.R. Herr 348 (RMS) – Virginia, Montgomery Co., Poverty Hollow, Pandapas Pond Rec. Area, Jeff. Nat. Forest, off Service Road 708, under mixed conifers/hardwoods, 07.08.2000, J.R. Herr 574 (RMS) – Tennessee, Cocke Co., Great Smoky Mountains National Park, Maddron Bald trail, between Gabed mountain trail & the Allbright grove, near Cosby, 777 m a.s.l., N35°45.352' W083°16.321', under *Tsuga canadensis*, 12.06.2004, J. Nuytinck 2004-003 (GENT) – Tennessee, Cocke Co., Great Smoky Mountains National Park, Greenbrier Ranger Station, second growth forest with *Pinus* spp., *Quercus* spp., *Tsuga canadensis* etc., 13.06.2004, J. Nuytinck 2004-006 (GENT) – North Carolina, Transylvania Co., Pisgah forest, close to Asheville, rich and mixed forest, under *Tsuga canadensis*, along creek, 17.06.2004, J. Nuytinck 2004-014 (GENT).

DISCUSSION: The dirty pinkish colour of the basidiocarps, the vinaceous red latex and the subdistant lamellae make *L. subpurpureus* an easy species to recognise. Microscopically, the large, ellipsoid spores and conspicuous pleuromacrocytidia are characteristic. *Lactarius paradoxus* is an eastern species with similarly coloured latex but is readily distinguished from *L. subpurpureus* by the colour of the cap and the spacing of the lamellae. *Lactarius miniatosporus* is superficially similar to *L. subpurpureus* but has much smaller spores and lacks pleuromacrocytidia (Montoya & Bandala 2004). *Lactarius subpurpureus* is closely related to two western species with red latex: *L. barrowsii* and *L. rubriviridis*.

11. *Lactarius thyinos* A.H. Sm., Brittonia 12: 135 (1960)

Figs. 14, 16

Holotype: Smith 22150 (MICH!), USA: Michigan, Cheboygan County, Reese's Bog.

DESCRIPTION (macroscopy after Hesler & Smith 1979, Kuo 2004): Pileus 3–9 cm diam., convex at first, becoming applanate, with a shallow central depression to broadly infundibuliform; margin bent downwards to straight; surface viscid when fresh to thinly slimy, glabrous, zonate, zones carrot orange to salmon orange, alternating with pallid

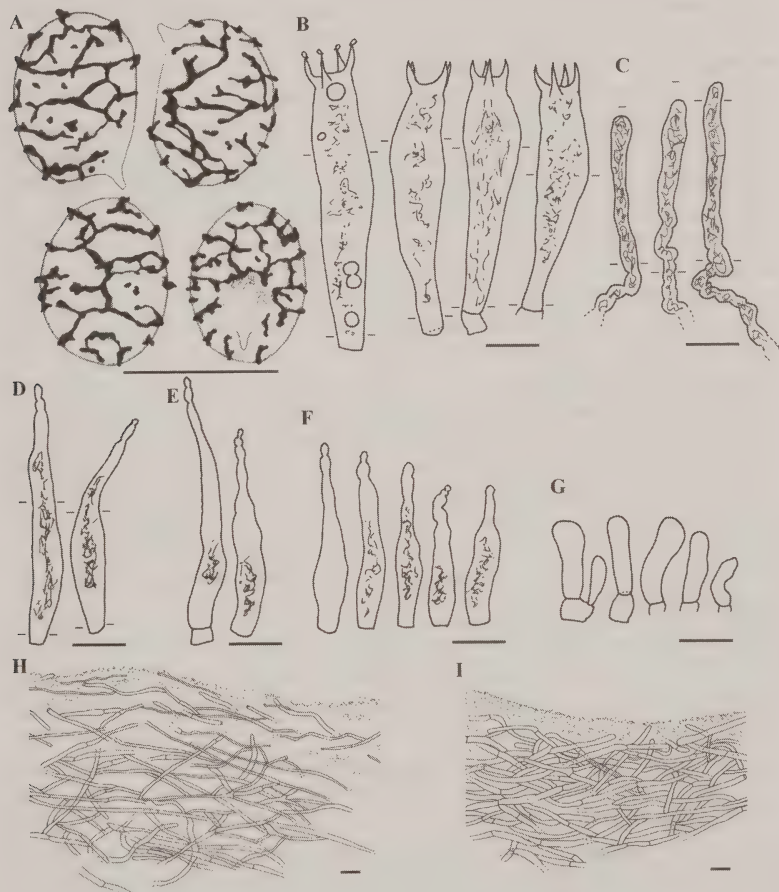


Fig. 16: *Lactarius thyinos*. A. spores; B. basidia; C. pseudocystidia; D. pleuromacrocystidia; E. macrocystidia close to the lamella edge; F. cheilomacrocystidia; G. cheileptocystidia; H. section through the pileipellis; I. section through the stipitipellis. From A.H. Smith 22150 (type) and S.L. Miller 9648. Scale bars = 10 μ m, small bars indicate the height of the hymenium.

yellow zones, in age weathering to greyish. Lamellae broadly adnate to decurrent, close at first, subdistant when mature; colour at first bright ochraceous salmon, gradually paler orange, when bruised staining (dark) vinaceous brown, not staining green at any stage. Stipe 4–8 × 0.8–2.0 (3.5) cm, more or less equal, or tapering somewhat to base; surface smooth, when young and fresh covered with a thin layer of slime but soon dry, often with a whitish sheen especially above; colour bright ochraceous salmon or paler, slowly staining dull vinaceous red to vinaceous brown where cut. Context thin, becoming hollow and fragile in the stipe, staining orange-buff when cut, in the base of the stipe staining slowly to vinaceous red; smell faintly fragrant; taste mild. Latex bright orange, slowly staining tissues (especially base of stipe) vinaceous red, no stains to green evident anywhere. Spore deposit pale yellow.

FeSO₄ no reaction, KOH no reaction, NH₄OH no reaction.

Spores 9.2–10.1–10.7–11.7 × 6.7–7.4–8.2–8.7 µm, broadly ellipsoid to ellipsoid (Q = 1.24–1.31–1.36–1.45); ornamentation up to 0.5 µm high, of thin ridges and isolated warts, forming an incomplete reticulum with rather wide meshes; plage distinct but almost inamyloid to distally slightly amyloid. Basidia 40–55 (60) × 8–11 µm, subclavate, 4-spored or rarely 2-spored, often with a granular content and containing oil-droplets; sterigmata 4–6 µm long. Pleuromacrocystidia abundant near the lamella edge, 40–80 × 4.5–8 µm, strongly emergent, subfusiform with a (long) moniliform apex, with a refractive, granular to needle-shaped content, thin-walled. Pseudocystidia relatively scarce, 3.3–5 µm broad, tortuous to cylindrical, inconspicuous, not emergent, pale yellow coloured (observation in KOH), hyaline in the apex. Lamella edge sterile with rather scarce cheilomacrocystidia; cheileptocystidia 8–20 × 2.7–6 µm, subclavate to more irregular, hyaline, thin-walled; cheilomacrocystidia 25–55 × 4–8 µm, strongly emergent, subfusiform with a moniliform apex. Subhymenium composed of almost isodiametric cells, sometimes arranged in rows. Hymenophoral trama with very abundant, pale yellow to ochre coloured lactifers. Pileipellis an ixocutis, 100–200 µm thick, composed of strongly interwoven and mainly shrivelled hyphae, 1–4 µm diam. Stipitipellis an ixocutis, up to 70 µm thick, with a distinct slime-layer; composed of regularly shaped hyphae, 2–4 µm diam. Clamp-connections absent.

HABITAT: Scattered to gregarious in woods of *Thuja* and in cold *Thuja* bogs and swamps, summer and fall, common, host tree unknown.

DISTRIBUTION: Northeastern USA (Vermont, New York and Michigan) and Canada (Nova Scotia, Ontario and Quebec).

COLLECTIONS EXAMINED: USA, Michigan, Cheboygan, Carp Creek, Reese's Bog, 20.08.1946, A.H. Smith 22150 (MICH), holotype – New York, St. Lawrence Co., Star Lake, 26.09.1997, S.L. Miller 9648 (RMS).

DISCUSSION: *Lactarius thyinos* is a medium-sized species with a viscid (when fresh), zonate pileus and a carrot to salmon orange coloured pileus and stipe. When bruised the basidiocarps show vinaceous brown stains but never turn green. The spores are large and ornamented with a rather fine, incomplete reticulum. *Lactarius thyinos* has all of these characters in common with its European and Asian sister species *L. salmonicolor* and *L. laeticolor*. It is unclear with which tree *L. thyinos* forms ectomycorrhiza (*Thuja* spp. are reported not to be ectomycorrhizal, Simard et al. 1997).

12. The “*L. deliciosus*” complex in North America

Based on the available material, the taxonomic problems of this complex of varieties described from or recognised in North America could not be solved. Hesler & Smith (1979) report four varieties from eastern and western North America: *L. deliciosus* var. *olivaceosordidus*, var. *areolatus*, var. *piceus* and var. *deterrimus*.

First and most importantly, we showed with our phylogenetic analyses that these taxa form a separate clade and are not conspecific with *L. deliciosus* or with *L. deterrimus* occurring in Europe (and Asia). Bessette et al. (1997) already suggested the name *L. deliciosus* is misapplied in North America. Secondly, we want to remark that in our opinion *L. deliciosus* var. *piceus* (an invalid name) and *L. deterrimus* are taxonomic synonyms and should not be used alongside. But finally, we did not obtain any further resolution or obvious separation of taxa within this complex in our molecular analysis. Only one collection identified as *L. deliciosus* var. *olivaceosordidus* is convincingly different from the other collections in our phylogenetic analyses. It is described under the insufficiently known taxa and unidentified collections hereunder.

Main morphological characters that are used to separate the varieties are the presence and abundance of pleuromacrocystidia, the colour of the pileus and the staining reaction of the context (remaining orange or slowly staining red). These characters have to be used with care because they are known to show quite some variability in *Lactarius* sect. *Deliciosi*.

Hesler & Smith (1979) mention the problem of obtaining apparently mixed collections. Our own experiences support this. Specimens J. Nuytinck 2003-041a & b were collected at the same site and time in Wyoming and showed no differences at first sight. A closer look at the discolouration of the latex showed that J. Nuytinck 2003-041a had unchanging to very slowly (> 1 h) changing orange latex while J. Nuytinck 2003-041b possessed orange latex becoming red in 10 to 15 min. Neither ITS nor *gpd* sequences from the separated collection were identical but they did both fall in the “*L. deliciosus*” clade together with all other collections of “*L. deliciosus*” from North America.

One taxon, *L. deliciosus* var. *areolatus*, is characterised by clearly larger spores. Sequenced specimens of this variety do group together in the ITS tree, but fall within the larger “*L. deliciosus*” clade. The *gpd* phylogeny shows a closer relationship to *L. porninsis*, *L. rubrilacteus* and an unidentified collection from Washington.

For the moment, we decided not to draw any further taxonomical conclusions and consequently not to propose any new names. We describe *L. deliciosus* var. *areolatus* and var. *olivaceosordidus* in the following part; for both taxa the type specimen was studied. The macroscopical descriptions were adapted from Hesler & Smith (1960, 1979) and Methven (1997) and we refer to these publications for more details on the other varieties. Methven (1997) distinguishes four varieties in California: *L. deliciosus* var. *olivaceosordidus*, var. *areolatus*, var. *piceus* and var. *deliciosus*. Table 1 gives a comparison of the distinguishing characters Methven (1997) describes.

Table 1. Summary of the most important features distinguishing the varieties of “*L. deliciosus*” treated in Methven (1997).

<i>L. deliciosus</i> var.	Colour: pileus	Colour: latex	Pleuro- macrocyttidia	Habitat: host tree
<i>areolatus</i>	brownish to greyish orange or plain orange	orange, staining context reddish	absent	montane coniferous-deciduous forests
<i>deliciosus</i>	obscurely zonate, brownish to greyish orange	orange, unchanging	absent	<i>Picea sitchensis</i> ?
<i>olivaceosordidus</i>	greyish green with orange tinges	orange, unchanging	present	<i>Picea sitchensis</i> ?
<i>piceus</i>	light to greyish orange	orange, staining context reddish	present	<i>Picea</i> spp.

12.1. *Lactarius deliciosus* var. *areolatus* A.H. Sm., Brittonia 12: 135 (1960) Fig. 17

Holotype: Smith 46914 (MICH!), USA: Idaho, Payette Lakes

DESCRIPTION (after Hesler & Smith 1960, 1979, Methven 1997): Pileus 5–15 cm diam., convex becoming convex-depressed to ± plano-depressed or broadly infundibuliform in age; surface glabrous and shining, thinly slimy to merely viscid and soon becoming dry, sometimes becoming areolate-scaly, zonate to azonate; colour variable, orange (6A6/7), brownish orange (5C4-6) or greyish orange (6B4-6), soon staining greyish green (26C3/4) to dull green (26D3/4), often sordid in age as the green staining becomes apparent. Lamellae adnate to subdecurrent, narrow to moderately broad, close to subdistant, forked near the stipe; colour light orange (5A3/4), slowly staining reddish brown (8D4-6), then dull green (26D3-4), finally entirely green in age; edge concolorous. Stipe 2–5 (10) × 1–3 (4) cm, ± equal; surface glabrous, dry, not to slightly scrobiculate; colour light orange (6A3/4) and dull, pruinose at first. Context firm, thick, brittle, soon hollow in the stipe; colour white to pale yellow (4A2/3), staining pale orange-buff, slowly changing to greyish red (8C3/4) or reddish brown (8D4-6) on exposure; smell not distinctive; taste mild becoming bitterish to ± acrid. Latex (very) scarce, orange (6A6/7), slowly staining purplish red to vinaceous red on the context. Spore deposit pale yellow (4A2/3).

FeSO₄ no reaction, KOH no reaction, phenol no reaction, NH₃ no reaction (Wells & Kempton in Hesler & Smith 1979).

Spores 8.5–9.2–9.8–10.5 (11) × 6.0–6.5–7.1–7.6 µm, broadly ellipsoid to ellipsoid (Q = 1.31–1.36–1.40–1.46); ornamentation up to 0.5 µm high, of medium thick ridges and some isolated warts, forming an incomplete reticulum with rather wide meshes; plage distinct and distally slightly amyloid. Basidia 45–60 × 8–12 µm, subclavate, 4-spored, often containing oil-droplets; sterigmata 3.5–4.5 µm long. Pleuromacrocyttidia absent or very scarce. Pseudocystidia abundant, 3.5–5.5 µm diam., tortuous, sometimes slightly emergent, sometimes branching, with an ochre content. Lamella edge sterile with abundant cheilomacrocyttidia; cheiloleptocystidia 8.5–20 × 3.2–7.3 µm, subclavate

to irregular, hyaline, thin-walled; cheilomacrocytidia $30\text{--}45 \times 5.3\text{--}6.7\ \mu\text{m}$, subfusiform with a moniliform apex, emergent, with and ochre, refractive, granular to needle-shaped content, thin-walled. Subhymenium composed of mainly small, irregular cells. Hymenophoral trama with abundant, wide lactifers, with an ochre-brown content in KOH. Pileipellis an ixocutis, $200\text{--}300\ \mu\text{m}$ thick, of strongly interwoven, rather dense, regularly shaped hyphae, $2\text{--}4\ \mu\text{m}$ diam.; few gelatinised and shrivelled hyphae present near the surface. Stipitipellis a cutis to ixocutis, up to $100\ \mu\text{m}$ thick, of mostly regularly shaped hyphae, $3\text{--}4\ \mu\text{m}$ diam.; shrivelled and gelatinised hyphae ($1\ \mu\text{m}$ diam.) present near the surface. Clamp-connections absent.

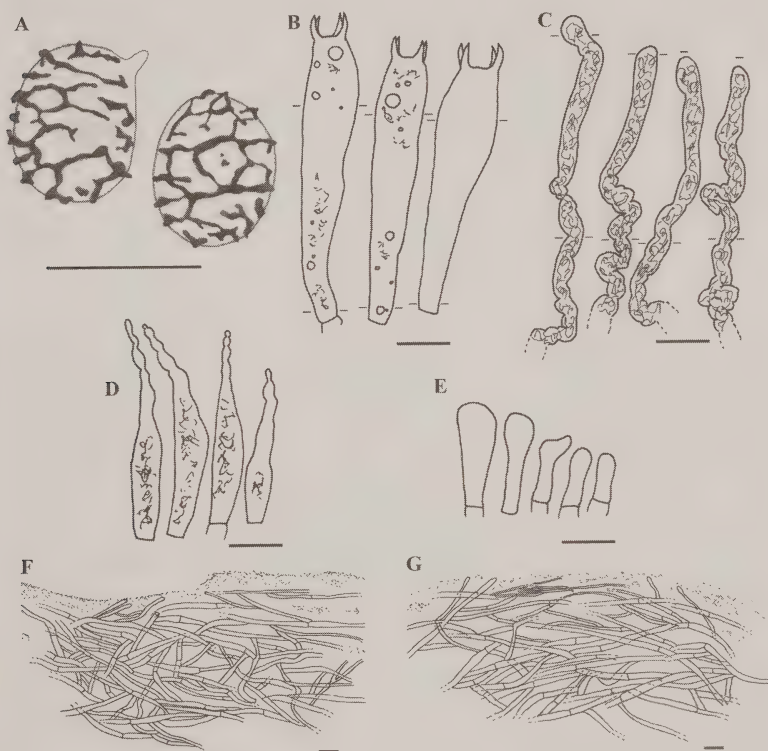


Fig. 17: *Lactarius deliciosus* var. *areolatus*: A. spores; B. basidia; C. pseudocystidia; D. cheilomacrocytidia; E. cheileleptocystidia; F. section through the pileipellis; G. section through the stipitipellis. From A.H. Smith 46914 (type) and A.S. Methven 360.

Scale bars = $10\ \mu\text{m}$, small bars indicate the height of the hymenium.

HABITAT: Scattered to gregarious under mixed conifers (Hesler & Smith 1979).

DISTRIBUTION: Western North America; reported from Alaska, California, Colorado, Idaho, New Mexico and Wyoming.

COLLECTIONS EXAMINED: USA, Idaho, Valley Co., Payette Lake, Payette National Forest, 27.08.1954, A.H. Smith 46914 (MICH), holotype – California, Sierra Co., Lincoln Creek Campground, Highway 49, scattered in duff in mixed forest under *Abies* and *Pinus*, 25.09.1982, A.S. Methven 1619 (SFSU) – California, Yuba Co., Schoolhouse Campground, Bullard's Bar Reservoir, gregarious in soil in mixed wood, 30.10.1982, H.D. Thiers 45335 (SFSU) – California, Mendocino Co., Jackson State Forest, solitary to scattered in duff in mixed forest, 07.11.1982, A.S. Methven 360 (SFSU) – California, Mendocino Co., Jackson State Forest, "*Suillus* Park": densely gregarious in duff in mixed forest, 12.12.1982, A.S. Methven 2301 (SFSU).

DISCUSSION: *Lactarius deliciosus* var. *areolatus* seems to be the most common variant of the "*L. deliciosus*" group in western North America (Hesler & Smith 1979, Methven 1997). The areolate condition of the cap, considered as a characteristic feature in the original description, is the result of dry weather conditions and is not present in normally developing basidiocarps (Hesler & Smith 1979). Hesler & Smith (1979) give an overview of the variability they encountered in the colour of the pileus, the taste and the discolouration of the latex in different collections from different regions.

12.2. *Lactarius deliciosus* var. *olivaceosordidus* Hesler & A.H. Sm.,
N. Amer. Species *Lactarius*: 95 (1979)

Fig. 18

Holotype: Smith 83831 (MICH!), USA: Oregon, Pacific City

DESCRIPTION (macroscopy after Hesler & Smith 1979, Methven 1997): Pileus 4–8 cm diam., plano-convex, soon becoming centrally depressed and in age broadly infundibuliform; margin incurved, faintly translucently striate; surface glabrous, thinly viscid, soon dry, obscurely zonate or scrobiculate; colour greyish green (27D4-6) on an orange (5A6/7), golden yellow (5B6/7) or brownish yellow (5C6/7) ground colour. Lamellae (sub)decurrent, close to subdistant, forked near the stipe; colour light orange (5A3-5), becoming dingy yellow, staining deep green where cut (25E7/8). Stipe 3–5 (7) × 0.5–1.0 (1.2) cm, slightly enlarged downwards; surface glabrous, moist to dry, not scrobiculate, orange (5A6/7), staining deep green (25E7/8). Context thin, yellowish centrally, olive underneath the pileipellis, staining orange when cut, unchanging; smell not distinctive; taste mild to very slowly slightly acid. Latex scarce, orange (6A6/7), unchanging on the context; taste mild. Spore deposit pale yellow (4A2/3).

Spores 8.4–9.0–9.4–9.9 × (6.3) 6.4–6.8–7.1–7.4 µm, broadly ellipsoid to ellipsoid ($Q = 1.23–1.30–1.36–1.44$); ornamentation up to 0.5 µm high, of thin and medium thick ridges and some isolated warts, forming an incomplete reticulum; plage almost inamyloid. Basidia 36–50 × 7–9 µm, subclavate, 4-spored, mostly hyaline; sterigmata 3–5.5 µm long. Pleuromacrocytidia abundant near the lamella edge, 45–70 × 4.5–7 µm, subfusiform but very slender, with a moniliform apex, containing needle-shaped crystals, thin-walled. Pseudocyttidia rather scarce to abundant, 3–5.5 µm broad, cylindrical to tortuous, not emergent, with a deep ochre coloured content in KOH. Lamella edge sterile with very abundant cheilomacrocyttidia; cheileptocyttidia 12–21 × 3.3–6 µm, subclavate, hyaline, thin-walled; cheilomacrocyttidia 25–47 × 4.5–7.3 µm, subfusiform and slender, with a moniliform or capitate apex, containing needle-shaped crystals, thin-walled. Subhymenium of irregularly arranged, small cells. Hymenophoral trama containing short hyphae and ochre coloured lactifers. Pileipellis an ixocutis, up to

300 μm thick, composed of mostly rather thick hyphae, 2–6 μm thick; shrivelled hyphae scarce; lactifers present close to the surface. Stipitipellis an ixocutis to cutis, up to 100 μm thick. Clamp-connections absent.

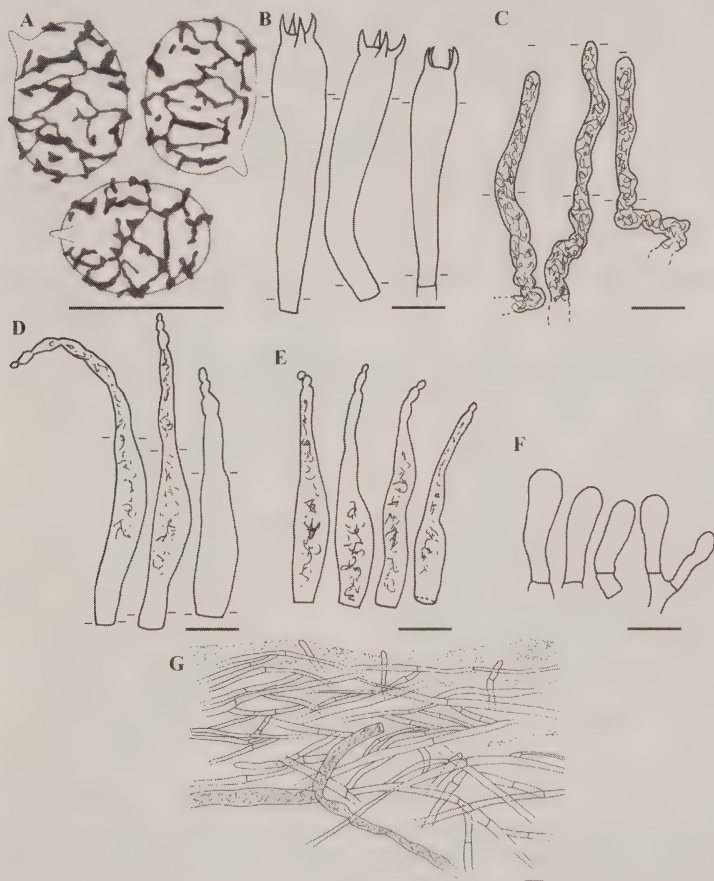


Fig. 18: *Lactarius deliciosus* var. *olivaceosordidus*: A. spores; B. basidia; C. pseudocystidia; D. pleuromacrocystidia; E. cheilomacrocystidia; F. cheileleptocystidia; G. section through the pileipellis. From A.H. Smith 83831 (type).

Scale bars = 10 μm , small bars indicate the height of the hymenium.

HABITAT: Scattered to gregarious under *Picea sitchensis*.

DISTRIBUTION: Western USA, reported to be uncommon in California (Methven 1997).

COLLECTIONS EXAMINED: USA, Oregon, Tillamook Co., Pacific City, under spruce, 15.11.1972, A.H. Smith 83831 (MICH), holotype – California, Del Norte Co., Wilson Creek Rd near Klamath, scattered in duff under *Picea sitchensis*, 23.10.1982, D.E.

Desjardin 1622 (SFSU) – California, Del Norte Co., Wakefield's Farm, Northcrest Dr, Crescent City, scattered in duff under *Picea sitchensis*, 23.10.1982, A.S. Methven 1840 (SFSU) – California, Humboldt Co., Big Lagoon, Patrick's Pt State Park, gregarious in duff under *Picea sitchensis*, 24.10.1982, A.S. Methven 1895 (SFSU) – Washington, Grays Harbor Co., Quinault Research Natural Area, 10-1-d-11, in humus, litter & mosses, *Tsuga* and *Picea*, 02.10.1992, JA 10762 (RMS) – Washington, Grays Harbor Co., Griffiths-Priddy Ocean State Park, under Sitka spruce in sandy soil, 12.11.2000, P.B. Matheny 2054 (RMS).

DISCUSSION: The green to olive stains are a prominent feature of even young material in this variety. The dried basidiocarps are uniformly dingy orange-brown, washed green. Only a slight tendency to become red on cut surfaces was noted (Hesler & Smith 1979).

13. *Lactarius aurantiosordidus* Nuytinck & S.L. Mill. sp. nov.

Fig. 19

MYCOBANK NUMBER: MB 510020

Pileus 17–25 mm diam., *convexus ad leviter infundibuliformem*; *pileipellis laevis, leviter viscida, saepe leviter zonata, primo pallide sordide aurantia ad irregulare olivaceam, tum griseoviridis, atroviridis in centro. Stipes* 25–55 mm longus, 6–12 mm crassus, *regularis, leviter tomentosus, pileo concolorus, vix scrobiculatus. Lamellae adnatae ad leviter decurrentes, confertae, salmoneae, tum griseoaurantiacae. Contextus pallide griseoaurantiacus, sub pileipelle viridis, aurantiascens, gustu mitis vel leviter acris. Latex atro-aurantiacus, virescens.*

Sporae late ellipsoideae ad ellipsoideas, 8.7–9.3–9.9 × (6.5) 6.6–7.0–7.5 µm, incomplete ad subcomplete reticulatae, verrucis et cristis usque ad 0.5 µm ornatae; macula suprahilaris non amyloidea. Basidia 40–55 × 8–11 µm, *subclavata. Pleuromacrocystidia dispersa, 40–45 × 6–8 µm. Pseudopleurocystidia abundantia. Pileipellis ixocutis.*

Typus: USA, California, Davison Road, near Humboldt, N41° 21.287' W124° 04.127', scattered or in small groups under Redwood, Sitka spruce with Hemlock and Red alder nearby, 23.10.2003, S.L. Miller 213-03 (holotypus RMS!, isotypus GENT!).

Etymology: *aurantio* (Lat.): orange-coloured, *sordidus* (Lat.): dirty-looking, dingy, soiled.

DESCRIPTION: *Pileus* 2–5.5 cm diam., broadly convex at first, then plane to slightly wavy or slightly upturned, shallowly infundibuliform with a small central depression with age; margin slightly incurved to downturned when young, becoming plane, mostly entire but occasionally with faint or moderately well developed transverse wrinkles or lobes, not striate; surface smooth, glabrous, thinly viscid and shiny when moist, drying quickly, often faintly zonated; colour pale dirty orange (6B3–5) when young, zonations slightly paler (5B3), soon flushed or mottled with olive to greyish green (28/29D4–6), often darker green (to 28/29E6/7) centrally but green tinges mostly lacking at the margin. *Lamellae* adnate to slightly decurrent, crowded when young, becoming close; colour salmon to pinkish orange (6A3) when young, dull greyish orange (6B3) in age; edge entire. *Stipe* 2.5–5.5 × 0.6–1.2 cm, mostly equal, occasionally tapered below, sometimes irregularly shaped; surface faintly tomentose or felted when young, remaining so at the base but felted aspect soon disappearing where handled, basal tomentum whitish to buff, scrobicules rare or absent, concolorous with the *pileus*, frequently paler at the apex.

Context firm and solid when young, becoming hollow in the stipe; colour pale greyish orange (6A2) when young but greenish immediately beneath the pileipellis, discolouring orange near the lamellae and in the stipe when cut; smell indistinctive; taste mild to very slowly faintly acrid. Latex scarce, dark orange when fresh, slowly turning to green on the context in an hour or more. Spore deposit pale yellow-orange (between 4A2 and 4A3).

FeSO_4 becoming quickly dull green.

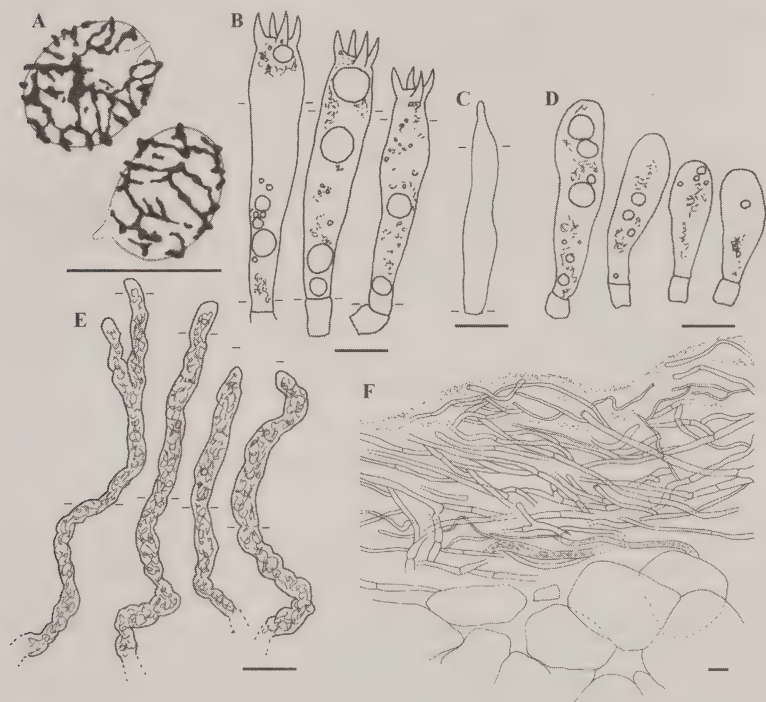


Fig. 19: *Lactarius aurantiosordidus*: A. spores; B. basidia; C. pleuromacrocytidium; D. marginal cells; E. pseudocystidia; F. section through the pileipellis. From S.L. Miller 213-03 and S.L. Miller 216-03.

Scale bars = 10 μm , small bars indicate the height of the hymenium.

Spores $8.7\text{--}9.3\text{--}9.9 \times (6.5) 6.6\text{--}7.0\text{--}7.5 \mu\text{m}$, broadly ellipsoid to ellipsoid ($Q = 1.24\text{--}1.32\text{--}1.39$); ornamentation up to $0.5 \mu\text{m}$ high, of medium thick ridges and isolated warts, forming an incomplete reticulum; plage mostly not amyloid. Basidia $40\text{--}55 \times 8\text{--}11 \mu\text{m}$, subclavate to almost cylindrical, with a striking, dark coloured, granular content and abundant, pigmented oil-droplets. *Basidioles* with a similar content to the basidia, only very few hyaline basidioles present. *Pleuromacrocytidia* very scarce, $40\text{--}45 \times 6\text{--}8 \mu\text{m}$, slightly emergent, subfusiform with a narrowing apex, hyaline, thin-walled. *Pseudocystidia* very abundant, $2.5\text{--}5.5 \mu\text{m}$ broad, sometimes slightly emergent, tortuous to cylindrical, sometimes branching, with a striking, deep ochre-brown colour. Lamella

edge sterile without cheilomacrocytidia; marginal cells $20\text{--}35 \times 7\text{--}10\text{ }\mu\text{m}$, subclavate, with a dark coloured granular content and oil-droplets. Pileipellis a thin ixocutis, up to $100\text{ }\mu\text{m}$ thick, composed of strongly interwoven hyphae, $1.5\text{--}5\text{ }\mu\text{m}$ broad, shrivelled hyphae scattered, pigmented hyphae and lactifers present close to the surface. Clamp-connections absent.

HABITAT: Probably associated with *Picea sitchensis*.

DISTRIBUTION: USA, California.

COLLECTIONS EXAMINED: USA, California, Davison Road, near Humbolt, N41° 21.287' W124° 04.127', scattered or in small groups under Redwood, Sitka spruce with Hemlock and Red alder nearby, 23.10.2003, S.L. Miller 213-03 (RMS) – California, Davison Road, near Humbolt, N41° 21.287' W124° 04.127', scattered or in small groups under Redwood, Sitka spruce with Hemlock and Red alder nearby, S.L. Miller 216-03 (RMS).

DISCUSSION: In our molecular analyses these collections do not group with any of the known species. Although there is a resemblance with *L. deliciosus* var. *olivaceosordidus*, these specimens do not group with the collections of "*L. deliciosus*" from North America. This species is characterised by its small size and its dirty orange tinges and extensive dirty greenish discolouration. The dried specimens are conspicuously dark in colour. Microscopically, the strongly and deeply pigmented content of nearly all hymenium elements is striking. Strongly pigmented hyphae were also noted in the pileipellis. The collections lack cheilomacrocytidia and pleuromacrocytidia are scarce.

Insufficiently known taxa and unidentified collections

Lactarius salmonicolor R. Heim & Leclair, Rev. Mycol. (Paris) 18: 221 (1953)

Heim (1953) reports *L. salmonicolor* from the col de Toluca, Mexico under *Abies religiosa*. The herbarium material that he deposited in PC unfortunately seems to be lost. Kong Luz (1995) also gives a detailed macro- and microscopical description of collections of *L. salmonicolor* from Mexico that resembles the European *L. salmonicolor* very well. Only the spore size he reports ($8.8\text{--}9.35 \times 6.43\text{--}7.28\text{ }\mu\text{m}$ on average) is smaller than what we measured from European material ($10.0\text{--}10.6 \times 7.3\text{--}8.2\text{ }\mu\text{m}$ on average). Furthermore Kong Luz (1995) admits a more detailed comparison with *L. thyinos* is necessary. We were unable to study collections identified as *L. salmonicolor* from Mexico or elsewhere in North America and thus do not draw any further conclusions.

Lactarius sp. Collection MTS 3445 (RMS)

originally identified as *L. deliciosus* var. *olivaceosordidus*

Fig. 20

MICROSCOPICAL DESCRIPTION: Spores (8.5) $8.6\text{--}9.1\text{--}9.6 \times 6.3\text{--}6.8\text{--}7.4\text{ }\mu\text{m}$, broadly ellipsoid to ellipsoid ($Q = 1.27\text{--}1.33\text{--}1.40$); ornamentation up to $0.5\text{ }\mu\text{m}$ high, of medium thick ridges and isolated warts, forming an incomplete reticulum; plage distally slightly amyloid. Basidia $40\text{--}50 \times 9\text{--}11\text{ }\mu\text{m}$, subclavate, 4-spored, mostly hyaline, sometimes with a granular content; sterigmata $3.5\text{--}5.5\text{ }\mu\text{m}$ long. Pleuromacrocytidia scarce, $45\text{--}55 \times 5\text{--}7\text{ }\mu\text{m}$, emergent, subfusiform with a tapering apex, sometimes slightly constricted at the apex but not capitate and never moniliform, hyaline and inconspicuous, thin-walled. Pseudocystidia abundant, $2\text{--}5\text{ }\mu\text{m}$ broad, not emergent, tortuous to cylindrical, with

and ochre-yellow content. Lamella edge sterile with rather scarce cheilomacrocystidia; cheileleptocystidia $7\text{--}25 \times 3.5\text{--}8\text{ }\mu\text{m}$, subclavate or more irregular, hyaline, thin-walled; cheilomacrocystidia small, $20\text{--}25 \times 4\text{--}7\text{ }\mu\text{m}$, only slightly emergent, subfusiform with a capitate to rarely moniliform apex, often apex merely tapering, content granular or needle-shaped, thin-walled. Subhymenium composed of small, $\pm$ isodiametric cells. Hymenophoral trama with abundant lactifers except near the edge. Pileipellis an ixocutis, up to $250\text{ }\mu\text{m}$ thick, composed of strongly interwoven hyphae, $1\text{--}5\text{ }\mu\text{m}$ broad, shrivelled hyphae only present near the surface, some extracellularly pigmented hyphae and lactifers present close to the surface. Clamp-connections absent.

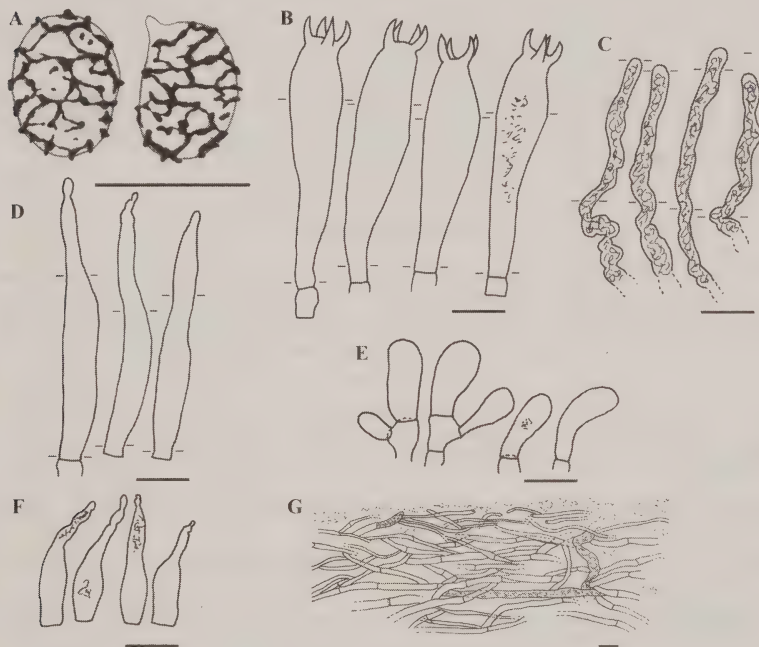


Fig. 20: *Lactarius* sp.: A. spores; B. basidia; C. pseudocystidia; D. pleuromacrocystidia; E. cheileleptocystidia; F. cheilomacrocystidia; G. section through the pileipellis. From MTS 3445.

Scale bars = $10\text{ }\mu\text{m}$, small bars indicate the height of the hymenium.

COLLECTION EXAMINED: USA, Washington, Grays Harbor Co., Quinault Research Natural Area, plot 10-1-c-11 (0), solitary on moss covered conifer twig & surrounding conifer debris, common, 07.10.1992, G. Walker, J. Ammirati & M. Seidl, MTS 3445 (RMS).

DISCUSSION: This specimen was included in our phylogenetic analyses and was originally identified as *L. deliciosus* var. *olivaceosordidus*. In both ITS and *gpd* phylogenies, this collection does not fall in the "*L. deliciosus*" clade from North America. It was collected

in Washington at the same site as collection JA 10762 (RMS) that also was identified as *L. deliciosus* var. *olivaceosordidus*. Collection JA 10762 however, groups with the other specimens identified as "*L. deliciosus*" or one of its varieties collected in North America in the molecular analyses. This means that *L. deliciosus* var. *olivaceosordidus* as currently identified in North America is polyphyletic. Based on microscopical data alone, it is impossible to draw any further conclusions. The microscopical features of this collection are very similar to those of the type of *L. deliciosus* var. *olivaceosordidus*. The spores are practically identical in size and ornamentation. The only differences noted concern the pleuro- and cheilomacrocytidia. Collection MTS 3445 (RMS) has rather exceptional pleuromacrocytidia with a narrowing or sometimes a slightly constricted apex that never is capitate or moniliform as in the type material of *L. deliciosus* var. *olivaceosordidus*. Furthermore the cheilomacrocytidia are scarce in MTS 3445 while they are very abundant in the type of *L. deliciosus* var. *olivaceosordidus*.

In conclusion and as Horton (2002), who revealed three different ITS-RFLP types in "*L. deliciosus*" from a locality in Oregon, already indicated, especially the "*L. deliciosus*"-complex needs more taxonomic attention in North America.

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A new species of *Cephalotheca* isolated from a Korean patient

TAKASHI YAGUCHI^{1*}, AYAKO SANO¹, KYOKO YARITA¹,
MOO KYU SUH², KAZUKO NISHIMURA¹ &
SHUN-ICHI UDAGAWA³

*t-yaguchi@faculty.chiba-u.jp

¹Research Center for Pathogenic Fungi and Microbial Toxicoses
Chiba University, 1-8-1 Inohana, Chuo-ku, Chiba 260-8673, Japan

²Department of Dermatology, Gyeongju Hospital, College of Medicine
Dongguk University, Geyongju 780-350, Korea

³Tama Laboratory, Japan Food Research Laboratorie
6-11-10 Nagayama, Tama-shi, Tokyo 206-0025, Japan

Abstract—The causative agent isolated from a Korean patient with subcutaneous fungal infection is described as *Cephalotheca foveolata*, a new species of *Cephalotheca*, *Cephalothecaceae*, Ascomycota. It is characterized by globose cleistothecia, covered with yellow to brown hairs, cephalothecoid peridium, prototunicate asci, broadly reniform and foveolate ascospores, and a *Phialemonium*-like anamorph. Based on the analysis of sequences of the D1/D2 region of 28S rDNA, the fungus is phylogenetically a member of *Cephalotheca*. This is a new record of the genus from a patient with a human mycosis.

Key Words—systematics

Introduction

The genus *Acremonium* Link and its related genera such as *Lecythophora* Nannf., *Phaeoacremonium* W. Gams et al. and *Phialemonium* W. Gams & McGinnis have been increasingly isolated as causative agents in cases of opportunistic and/or emerging human infections (Fincher et al. 1991, Guarro et al. 1997, 2003, Padhye et al. 1998, Matsui et al. 1999, Kitamura et al. 2000, Alfonso et al. 2004, Kan et al. 2004, Proia et al. 2004, Scott et al. 2004, Mostert et al. 2006). With the exception of *Acremonium alabamense* Morgan-Jones (teleomorph: *Thielavia terrestris* (Apinis) Malloch & Cain), *Phaeoacremonium kraidenii* L. Mostert et al. (teleomorph: *Togninia kraidenii* L. Mostert et al.), *P. parasiticum* (Ajello et al.) W. Gams et al. (teleomorph: *T. parasitica* L. Mostert et al.), *P. rubrigenum* W. Gams et al. (teleomorph: *T. rubrigena* L. Mostert et al.) and *Lecythophora* sp. (teleomorph: *Coniochaeta ligniaria* (Grev.) Masee), pathogenic species of these genera could not produce ascospores on an artificial culture. We isolated a *Phialemonium*-like fungus from a Korean patient with chronic subcutaneous infection in the foot. The isolate produced

a teleomorph similar to those of *Cephalotheca sulfurea* and *Albertiniella polyporicola* (= *Cephalotheca polyporicola* Jacz.) in the *Cephalothecaceae*, *Sordariales* (Chesters 1934, Booth 1961, Jacevski 1922, Petrak 1947, Udagawa & Horie 1971, Malloch & Cain 1972, Lundqvist 1992). However, the phenotypic and genotypic characteristics of this isolate were different from those of both these species and other known species. Based on this evidence, we concluded that the isolate proved to be sufficiently different from those previously described to warrant the proposal of a new taxon of the genus *Cephalotheca* Fuckel. This is a new record of this genus as a human pathogen.

Materials and Methods

Fungal isolate

The strain was isolated from a Korean patient with chronic subcutaneous infection of the foot at Gyeongju Hospital, College of Medicine, Dongguk University, Gyeongju, Korea, in 2002. For comparison, the strains used in this study are listed in Tables 1 and 2, along with their strain numbers and GenBank accession numbers.

Incubation and observation

The isolate was incubated at 25–40°C under natural light or continuous near UV-light on potato-dextrose agar (PDA) and oatmeal agar (OA). For 14–80 days, colonies were examined by a light microscope (LM) and a scanning electron microscope (SEM: Hitachi S-800, Tokyo, Japan). Colony colors were designated according to the Methuen Handbook of Colour (Kornerup & Wanscher 1978).

Deposition of fungal materials

The type specimen and freeze-dried type culture were deposited in the Research Center for Pathogenic Fungi and Microbial Toxicoses, Chiba University, Chiba, Japan (IFM 53377) and the Department of Biotechnology, National Institute of Technology and Evaluation, Kisarazu, Chiba, Japan (NBRC 100905).

DNA analyses

DNA was extracted with a DEXPAT™ (TaKaRa, Ohtsu, Japan) kit. The D1/D2 region of 28S rDNA was sequenced directly from PCR products using primer pair NL-1 (5'-GCA TAT CAA TAA GCG GAG GAA AAG-3') and NL-4 (5'-GGT CCG TGT TTC AAG ACG G-3') (Kurtzman & Robnett 1997). PCR products were sequenced using the BigDye Terminator Cycle Sequencing Ready Reaction Kit (Applied Biosystems, Foster City, Calif., US) on the ABI PRISM 3100 Genetic Analyzer (Applied Biosystems), according to the manufacturer's instructions.

DNA sequences were edited using ATGC Ver. 4 sequence assembly software (Genetyx Co., Tokyo, Japan), and alignment of the sequences was performed using Clustal X software (Thompson 1997). Maximum parsimony (MP) analysis (Fitch, 1971) was performed by heuristic search with random addition sequences and branch swapping by tree bisection-reconnection (TBR), using PAUP* 4b10 (Swofford, 2002). Relative robustness of the individual branches was estimated by bootstrapping, with 1000 replicates, using heuristic search and branch swapping by TBR. For the neighbor-

joining (NJ) analysis (Saitou & Nei 1987), the distances between sequences were calculated using Kimura's two-parameter model (Kimura 1980).

Table 1. List of taxa sequenced in this study

Taxon	Strain number	DDBJ* accession number
<i>Albertiniella polyporicola</i> (Jacz.) Malloch & Cain	NBRC 9424	AB178270
<i>Albertiniella polyporicola</i>	NBRC30914	AB178271
<i>Cephalotheca foveolata</i> Yaguchi, Nishimura & Udagawa sp. nov. (ex type)	IFM 53377 (= NBRC 100905)	AB178269
<i>Cephalotheca sulfurea</i> Fuckel	CBS 135.34	AB189153
<i>Cryptendoxyla hypophloia</i> Malloch & Cain (ex type)	CBS 508.70	AB191032
<i>Cryptendoxyla hypophloia</i>	CBS 138.78	AB191031
<i>Cryptendoxyla hypophloia</i>	CBS 509.70	AB191033
<i>Cryptendoxyla hypophloia</i>	CBS 661.93	AB191034
<i>Cryptendoxyla hypophloia</i>	CBS 796.84	AB191035
<i>Fragosphaeria purpurea</i> Shear	CBS 133.34	AB189154
<i>Fragosphaeria reniformis</i> (Sacc. & Therry) Malloch & Cain	CBS 134.34	AB189155
<i>Lecythophora hoffmannii</i> (J.F.H. Beyma) W. Gams & McGinnis	IFM 53859	AB189164
<i>Phialemonium curvatum</i> W. Gams & W.B. Cooke (ex type)	CBS 490.82	AB189156
<i>Phialemonium curvatum</i>	CBS 246.91	AB189157
<i>Phialemonium curvatum</i>	CBS 631.94	AB189158
<i>Phialemonium dimorphosporum</i> W. Gams & W.B. Cooke (ex type)	CBS 491.82	AB189159
<i>Phialemonium dimorphosporum</i>	CBS 492.82	AB189160
<i>Phialemonium obovatum</i> W. Gams & McGinnis (ex type)	CBS 279.76	AB189161
<i>Phialemonium obovatum</i>	CBS 116.74	AB189162
<i>Phialemonium obovatum</i>	CBS 396.82	AB189163

*: DNA Data Bank of Japan.

Table 2. List of additional taxa included in the analysis

Taxon	Strain number	GenBank accession number
<i>Acremonium alternatum</i> Link	CBS 223.70	U57349
<i>Lecythophora decumbens</i> (J.F.H. Beyma) E. Weber et al. (ex type)	CBS 153.42	AF353597
<i>Lecythophora fasciculata</i> (J.F.H. Beyma) E. Weber et al. (ex type)	CBS 205.38	AF353598
<i>Lecythophora mutabilis</i> (J.F.H. Beyma) W. Gams & McGinnis (ex type)	CBS 157.44	AF353604
<i>Pseudeurotium zonatum</i> J.F.H. Beyma	CBS 329.36	AF096198
<i>Xylaria hypoxylon</i> (L.) Grev.	ATCC42768	U47841
<i>Penicillium chrysogenum</i> Thom (out group)	NRRL 807	AF033465

Results

Phylogenetic analyses

DNA sequences of the D1/D2 region of 28S rDNA in the strains listed in Table 1 were determined. New sequences were deposited in the DNA Data Bank of Japan (DDBJ) and the accession numbers were listed in Table 1. Additional taxa included in the analysis are listed in Table 2.

MP analysis of D1/D2 sequences (Fig. 1) yielded a parsimonious tree based on 154 parsimony informative characters, 474 steps in length with a consistency index (CI) of 0.637 and a retention index (RI) of 0.666. No difference was seen between the tree topologies from the MP and NJ analyses (NJ-tree not shown).

According to the two trees, the isolate IFM 53377, *Albertiniella polyporicola*, *Cephalotheca sulfurea*, *Cryptendoxyla hypophloia* and *Phialemonium obovatum* formed a same clade and were found to be their placements in the *Cephalothecaceae*. The isolate was closely related to *C. sulfurea* and *P. obovatum*. In the D1/D2 region, there was 95% sequence homology between the isolate and *C. sulfurea*. Although the isolate is morphologically similar to *Albertiniella polyporicola*, there was only 90% sequence homology between the isolate and two NBRC strains of *A. polyporicola*. No relationship was evident with either *Fragosphaeria purpurea* or *F. reniformis*.

Morphological relationships

The genus *Cephalotheca* was described with a single species, *C. sulfurea*, collected on decaying oak boards in Rheingau. The species of *Cephalotheca* have the following characteristics in common: Ascomata are spherical, non-ostiolate, brown to black, with a membranaceous pseudoparenchymatous wall with sutures; asci are numerous, borne at all levels within the cavity of the ascoma, globose to pyriform, and generally disintegrate after the ascospores are formed; and ascospores are continuous, small,

brown, and globose to ellipsoidal or reniform. One of the above features common to the genus is the arrangement of the peridial cells to form plate-like complexes (Fig. 4). Each of these plates is made up of radiating groups of cells and is separated from adjacent plates by well-defined sutures of dehiscence. To describe such structures, we are using the term “cephalothecoid”, as in the cleistothecial ascomata of the *Cephalotheca* (Ulloa & Hanlin 2000). *Cephalotheca* and other cleistothecial ascomycetes have traditionally been separated using only the presence or absence of a cephalothecoid peridium. As a result, for those fungi with a cephalothecoid ascomatal peridium, several reports bring the number of additional species of *Cephalotheca* to approximately 15 (Booth 1961). With increasing taxonomical studies on the cleistothecial ascomycetes, however, such distinctions are regarded as largely artificial (Malloch & Cain 1970). Cephalothecoid peridia are found in a range of clearly unrelated ascomycetes, e.g. *Argynna* Morgan (Argynnaceae), *Chaetomidium* (Zopf) Sacc. (*Chaetomiaceae*), *Diffractella* Guarro et al. (*Lasiosphaeriaceae*), *Eremomyces* Malloch & Cain (*Eremomycetaceae*), *Rhytidospira* Jeng & Cain (*Ceratostomataceae*), *Testudina* Bizz. and its allies (*Testudinaceae*), *Thielavia* Zopf (*Chaetomiaceae*), and *Zopfia* Rabenh. and its allies (*Zopfiaceae*). Thus, included in the genus *Cephalotheca* were a number of unrelated taxa which are now distributed among several families as referred here. At present, in “Dictionary of the Fungi, 9th Edition”, four species of *Cephalotheca* were recognizable (Kirk et al. 2001).

The isolate is easily distinguished from known species of *Cephalotheca* and other morphologically similar genera in the *Cephalothecaceae* (Table 3). *Cephalotheca sulfurea* differs in that cleistothecia are seated on a small dense mat of sulfur-colored hyphae and its ascospores are broadly elliptic-fusiform rather than reniform (Chesters 1934, Booth 1961, Dennis 1978). *Cephalotheca clarkii* Dennis is very similar to the isolate as its cleistothecia with long stiff hairs emerge from the center of the polygonal segments of cleistothecial peridium and its ascospores have a punctate ornamentation. However, it differs because of its subglobose, large ascospores (Dennis 1974, 1978). *Cephalotheca zeyheriae* C. Ram is different from the isolate due to its smooth-walled cleistothecia covered with aerial mycelium and oval (not reniform) ascospores, which are brightly colored at maturity (Ram 1972). Apart from the marked difference shown by its *Tritirachium* anamorph, *Cephalotheca savoryi* C. Booth has small cleistothecia covered with white downy mycelium and smaller ascospores (Booth 1961).

The genera most similar to *Cephalotheca* are *Albertiniella* Kirschst. and *Cryptendoxyla* Malloch & Cain. *Albertiniella polyporicola* and the isolate differ little in their microscopic characteristics, except that the former can be distinguished by its larger (340-600 µm diam), glabrous cleistothecia and slightly smaller ascospores (Udagawa & Horie 1971, Lundqvist 1992). *Cryptendoxyla hypophloia*, the only known species of the genus so far, has been collected on several occasions beneath bark on the wood of dead standing trees and on logs in Canada and has been cultured (Malloch & Cain 1970). The genus is characterized by a cephalothecoid cleistothecial peridium, prototunicate asci, cylindrical brown ascospores and a phialidic *Chalara* anamorph. Recently this species was isolated as a contaminant from a human toenail mycosis in Canada (Suh et al. 1999).

Data for maximum growth temperatures have assisted in differentiating the isolate and two closely related species. The maximum growth temperature of the isolate is 39°C and distinct from that of *C. sulfurea* CBS 135.34 (28°C) and *A. polyporicola* NBRC 9424 and 30914 (31°C).

Taxonomy

Based on morphological characters as well as DNA phylogeny, we consider the isolate from a Korean patient to represent an undescribed species of *Cephalotheca*.

Cephalotheca foveolata Yaguchi, Nishim. & Udagawa, sp. nov. (Figs. 2-10)

Coloniae in agar decocto tuberorum effusae, velutinae, planae, ex mycelio basali coacto tenuiter constantes, albae, deinde aurantiaco-schistaceae; conidiogenesis moderata; cleistothecia abundantibus formentis sub luce naturali; reversum laete brunneum. Cleistothecia superficialia, sparsa, primum laete brunnea, deinde nigra, globosa vel subglobosa, 150-300 µm diam, non ostiolata, cum pilis rectis vel leviter sinuatis, laete flavis deinde brunneis; peridium cephalothecoidum, crassum, ex cellulis elongatis compositum. Asci 8-spori, pyriformes vel late ellipsoidei, evanescentes. Ascosporae primum hyalinae vel flavae, deinde brunneae, late reniformes, saepe complanatae, 4-5 × 3-4 × 2.5-3 µm, foveolatae sub SEM. Conidiophora destituta vel indistincta. Cellulae conidiogae terminales vel laterales, vulgo monophialidicae, cylindricae, (5-)10-20 × 2-3 µm, laeves. Conidia hyalina, cylindrica, 4-5 × 1.5-2 µm, laevia. Chlamydosporae terminales vel intercalares, hyalinae, globosae vel subglobosae, 3-6 µm diam, laeves et incrassatae.

Etymology: from Latin, *foveolata* = foveolate, referring to the ascospore ornamentation.

HOLOTYPE. IFM 53377, isolatus ex pede humano, Gyeongju, in KORIA, 2002, a Suh MK. **ISOTYPUS.** NBRC 100905.

Colonies on PDA growing more or less rapidly, attaining diam of 45-50 mm after 14 days at 25°C, velvety and loose-textured, plane, consisting of a thin basal felt, white, later becoming Orange Grey (M. 5B2) with a brownish exudation; conidiogenesis moderate; cleistothecia abundantly produced under natural light or near-UV light after more than 60 days; reverse Light Brown (M. 6D8) to Brown (M. 6E8). Colonies on OA growing more or less rapidly, attaining diam of 45-50 mm after 14 days at 25°C, plane, thin, consisting of spreading submerged mycelium, white to yellowish white, later becoming Brownish Orange (M. 6C3) with a brownish exudation; conidiogenesis and cleistothecial production similar to those on PDA; reverse uncolored to Greyish Orange (M. 6B6).

At 37°C, growth was slower than at 25°C. Maximum growth temperature was 39°C.

Cleistothecia superficial, scattered, at first pale brown, later becoming nearly black, globose to subglobose, 150-300 µm diam, non-ostiolate, with straight or slightly waved, light yellow, later becoming brown hyphal hairs. Peridium cephalothecoid (at maturity breaking into polygonal plates), thick-walled, multilayered, consisting of long elongated cells. Asci prototunicate, 8-spored, hyaline to pale brown, pyriform to broadly ellipsoidal, 6-8 × 4-6 µm, evanescent. Ascospores at first hyaline to yellow, later brown, broadly reniform, often flattened, 4-5 × 3-4 × 2.5-3 µm, with walls nearly smooth by LM and foveolate by SEM.

Conidial state *Phialemonium*-like. Conidiophores lacking or undifferentiated from the hyphae, simple or few branched, frequently reduced to conidiogenous cells. Conidiogenous cells terminal or lateral, determinate, mostly monophialidic, slender, cylindrical, (5-) 10-20 × 2-3 µm, smooth-walled. Conidia hyaline, cylindrical, 4-5 × 1.5-2 µm, smooth-walled, accumulated in slimy balls. Chlamydospores present, terminal or intercalary, globose to ellipsoidal, 3-6 µm diam, smooth, thick-walled.

Specimens examined. IFM 53377 (HOLOTYPE), a dried specimen and freeze-dried culture of an isolate from a Korean patient with subcutaneous fungal infection, Gyeongju Hospital, College of Medicine, Dongguk University Gyeongju, KOREA, by Suh MK, in 2002. Isotype. NBRC 100905.

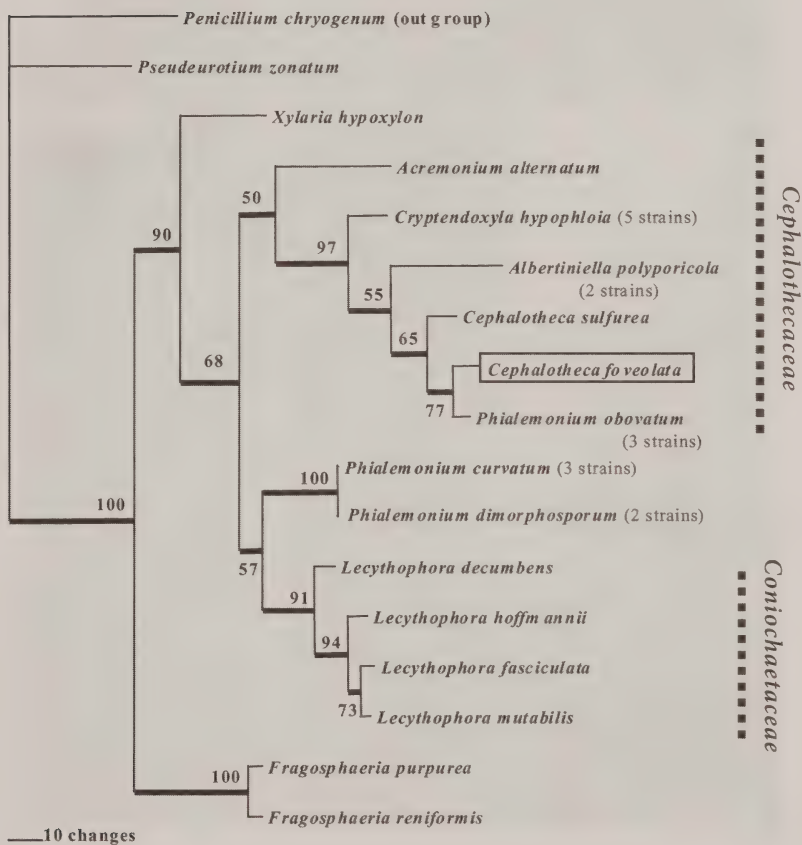
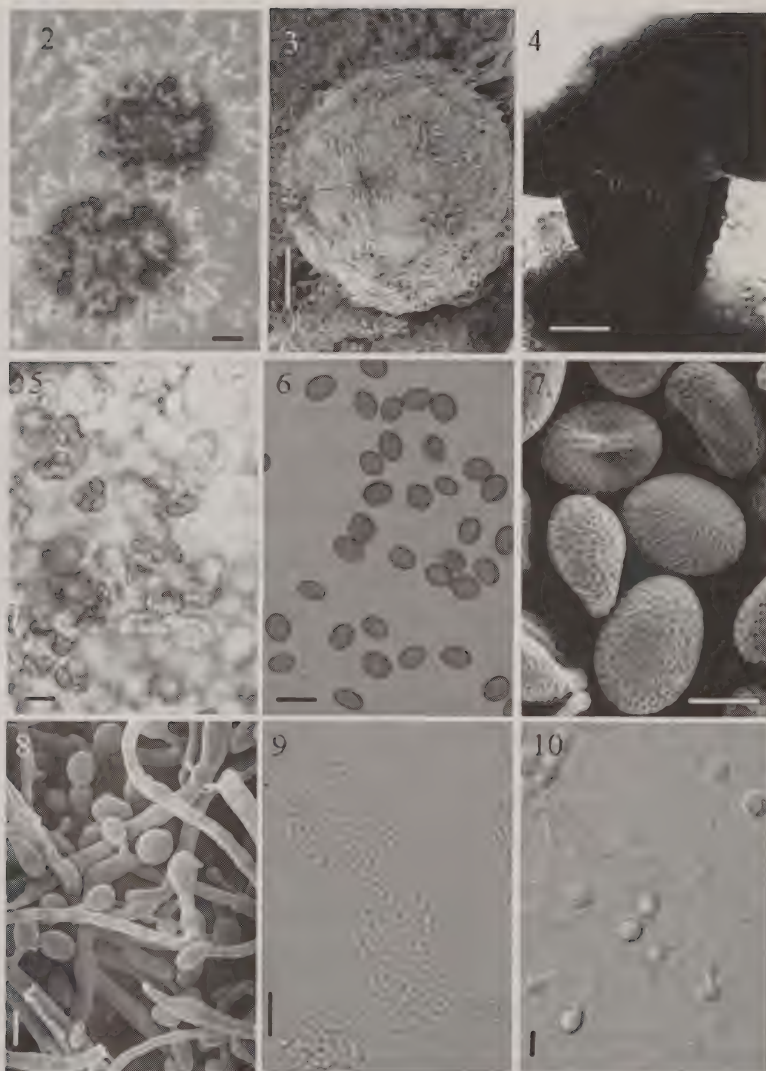


Fig.1. Single most parsimonious tree obtained from analysis of D1/D2 region of 28S rDNA using PAUP. Tree was 474 steps in length with CI of 0.637 and RI of 0.666. Percentages of 50% or higher based on 1000 bootstrap replications are given on tree branches accentuated as bold lines.



Figs.2-10. *Cephalotheca foveolata* IFM 53377. 2, 3. Cleistothecia. 4. Peridium. 5. Asci. 6, 7. Ascospores. 8, 9. Conidiogenous cells and conidia. 10. Chlamydospores. Scale bars: 2, 3, 4 = 50 μ m, 5, 6, 8-10 = 5 μ m, 7 = 2 μ m.

Table 3. Comparison of *Cephalotheca foveolata* IFM53377 to its related species

Fungus	Acosmatal covering	Ascospores	Anamorph	Classification	Homology* (%)
<i>Cephalotheca foveolata</i>	Yellow, straight or waved hairs	Reniform, 4.5 × 3.4 × 2.5-3 µm, foveolate	<i>Phialemonium</i> -like	<i>Cephalothecaceae</i>	-
<i>Cephalotheca sulfurea</i>	Sulfureous hyphae when young, then glabrous	Elliptic-ovate, 4.6 × 3.4 µm, smooth**	<i>Phialemonium</i> -like	<i>Cephalothecaceae</i>	95
<i>Cephalotheca clarkii</i>	Long, straight	Subglobose, 8.7 × 7.9 µm, reticulate	Lacking	<i>Cephalothecaceae</i>	ND***
<i>Cephalotheca savoryi</i>	White villous	Reniform, 2.5-3 × 2.5-3 × 1.5-2 µm, smooth**	<i>Tritirachium</i>	<i>Cephalothecaceae</i>	ND***
<i>Cephalotheca zeyheriae</i>	Glabrous	Oval, 4.6 × 3.5 µm, smooth**	<i>Phialemonium</i> -like	<i>Cephalothecaceae</i>	ND***
<i>Albertiniella polyporicola</i>	Glabrous	Reniform, 3.4 × 2.5-3.5 × 2-2.5 µm, reticulate	<i>Phialemonium</i> -like	<i>Cephalothecaceae</i>	90
<i>Cryptendoxyla hypophloia</i>	Glabrous	Cylindrical, 4.2-5.5 × 2-3 µm, smooth**	<i>Chalara</i>	<i>Cephalothecaceae</i>	93
<i>Fragosphaeria purpurea</i>	Purple villus when young, then glabrous	Reniform, 2.5-3 × 1.5-2 µm, smooth**	Sympoduloconidia	<i>Ophiostomataceae</i>	86
<i>Fragosphaeria reniformis</i>	Fulgiginous hairs when young, then glabrous	Reniform, 4.5 × 3-3.5 µm, smooth**	Sympoduloconidia	<i>Ophiostomataceae</i>	86

*: The value of the sequence homology with *C. foveolata* IFM 53377 on the D1/D2 region of 28S rDNA.

***: Not determined.

**: Observed by light microscope only.

Discussion

The family *Cephalothecaceae* was erected for *Cephalotheca* and a few similar cleistothecial ascomycetes with a specialized ascomatal structure for the liberation of the ascospores, showing a cephalothecoid peridium (Höhnelt 1917). Booth (1961) provided descriptions of four wood-inhabiting species of *Cephalotheca* that had been considered to be close relatives of *Pseudeurotium* J.F.H. Beyma.

Subsequently, Malloch & Cain (1970) proposed the family *Pseudeurotiaceae* in which they included nine genera: *Cryptendoxyla*, *Emericellopsis* J.F.H. Beyma, *Fragosphaeria* Shear, *Hapsidospora* Malloch & Cain, *Leuconeurospora* Malloch & Cain, *Mycoarachis* Malloch & Cain, *Nigrosabulum* Malloch & Cain, *Pseudeurotium*, and *Testudina* Bizz. In some genera of the *Pseudeurotiaceae* the ascomatal peridium is made of plates, a condition described as cephalothecoid. The *Pseudeurotiaceae* is characterized by generally dark cleistothecial ascomata containing prototunicate asci with dark ascospores that lack germ pores; the anamorphs are morphologically simple, and conidia are produced from phialides or by sympodial proliferation of the conidiogenous cells in some cases. The family is more or less equivalent to the *Cephalothecaceae*, but Malloch & Cain disregarded the cephalothecoid peridium as a valid family characteristic because this peridial characteristic has been found in a number of unrelated taxa. They included only the genus *Cephalotheca* in the *Cephalothecaceae*.

In 1972, Malloch & Cain revived *Cephalotheca polyporicola* as a new combination, *Albertiniella polyporicola*, and designated it to "Family Unknown" (Incertae sedis). They stated that *Albertiniella reticulata* Kirschst. (Kirschstein 1936) and *C. polyporicola* were conspecific and made the name *Albertiniella* available. Malloch noted that final disposition of the genus awaited the determination of the presence or absence of germ pores in its ascospores (Benny & Kimbrough 1980). The absence of germ pores would suggest a relationship to the *Pseudeurotiaceae*. Thereafter, detailed discussion and illustration of *A. polyporicola* were provided by Lundqvist (1992). The ascospores, previously described as smooth, were found to be reticulate under the SEM with no clear germ pores or slit, and a *Phialemonium*-like anamorph was noted. As defined by Malloch (1981), Lundqvist suggested that the genus continue to be retained in the probably heterogenous *Pseudeurotiaceae*.

The genus *Teberdinia* was recently established by Sogonov et al. (2005) to be related anamorphs of *Pseudeurotium* species. The anamorph state of *C. foveolata* was superficially similar to *Teberdinia*, but phylogenetically separated from the genus *Phialemonium* because the distant relationship was obviously observed between the *Phialemonium* species and *P. zonatum* in Fig. 1.

Recently Suh & Blackwell (1999) presented evidence to place cephalothecaceous and pseudeurotiaceous species among their closest relatives, although all of the relationships were not well resolved. Their molecular phylogenetic analysis by partial sequences of 18S rDNA and 28S rDNA revealed that some species in the *Pseudeurotiaceae* were closely related to the taxa of four different orders of the perithecial ascomycetes (*Hypocreales*, *Sordariales*, *Ophiostomatales* and *Xylariales*).

In their study, *Cephalotheca sulfurea* formed a monophyletic sister group with pseudeurotiaceous species of *Albertiniella* and *Cryptendoxyla*, and thus the

Cephalothecaceae was well supported as a lineage of cleistothecial ascomycetes within the *Sordariales*. Our molecular data concurred with this finding.

In the molecular studies of phylogenetic relationships of members of the *Sordariales*, the *Cephalothecaceae* was also confirmed by Huhndorf et al. (2004). Although it was provisionally placed in the *Sordariomycetidae* inc. sed., they suggested that the family could be placed in a new order *Coniochaetales*, which is separate from the *Sordariales* and clusters as a sister group to the *Xylariales* and *Hypocreales*.

A group of *Acremonium*-like fungi with slimy, commonly pink to salmon-colored or pale yellow (sometimes with brown chlamydospores) colonies comprises the anamorphs of *Coniochaeta* (Sacc.) Cooke. These fungi compose the genus *Lecythophora*, which has been reintroduced by Gams & McGinnis (1983) and more recently redefined by Weber (2002). *Lecythophora* is also characterized by the predominant occurrence of intercalary phialides (adelophialides). On the other hand, Gams & McGinnis (1983) erected the genus *Phialemonium* to accommodate another group of hyphomycetes intermediate between *Acremonium* and *Phialophora* Medlar. *Phialemonium* is characterized by white (not turning pink, but occasionally yellow green) colonies, short cylindrical, lateral intercalary phialides which either lack collarettes or have very inconspicuous collarettes, no visible periclinal wall thickening, and somewhat discrete slender ventricose phialides. Its narrow vegetative hyphae (0.5 µm diam) distinguish *Phialemonium* from the otherwise similar *Lecythophora*. These fungi tend to be similar morphologically, and identification based on micromorphology and/or colony characteristics is likely to continue to be difficult. However, *Lecythophora* and *Phialemonium* now are clearly separated and a reliable set of sequence data is available for most species of these genera. Analysis of 28S rDNA sequence data by Weber et al. (2002) clearly indicates a phylogenetic affinity between *Lecythophora* and *Coniochaeta* species; e.g. *L. lignicola* Nannf., the type species, as well as *L. hoffmannii*, *L. mutabilis*, *L. luteoviridis* (J.F.H. Beyma) E Weber et al., *L. decumbens*, and *L. fasciculata*, form a single cluster together with the tested species of *Coniochaeta*, including the type species, *C. ligniaria*, and associated *Lecythophora* anamorphs.

In this study, four species of *Lecythophora* have very similar DNA sequences and also appear as a monophyletic group (FIG. 1). On the contrary, our molecular data support the close relationships between *Phialemonium obovatum*, the type species, and three members of the *Cephalothecaceae*. The data obtained in this study strongly suggest that phialidic anamorphs of *Cephalotheca* and *Albertiniella* are placed in *Phialemonium* rather than *Lecythophora*. However, the placement of the other two species of *Phialemonium*, *P. curvatum* and *P. dimorphosporum* into the *Cephalothecaceae* was not supported by the analysis of rDNA sequence data (Weber et al. 2002, Fig. 1 in this study).

Species of *Acremonium* and related genera have increasingly been isolated from clinical materials, although their teleomorphs are not known. The teleomorphs include members of at least five families, the *Bionectriaceae*, *Nectriaceae*, *Cephalothecaceae*, *Coniochaetaceae* and *Phyllachoraceae*, but due to difficulties in recognizing and identifying these species in laboratory culture, these taxa are not familiar to most clinical mycologists. Prior to laboratory identification, cultures of these ascomycetous fungi should be incubated for at least three weeks under exposure to natural light or near-UV light, and hence their role in diseases may be underestimated. It appears that

reliable identification of these fungi will become even more dependent on molecular methodologies in the future.

This paper and the case report by Suh et al. (2006) are the first report of an ascomycete classified in the genus *Cephalotheca* as a causative pathogen in human diseases. Further extensive environmental sampling and ecological studies are needed on *C. foveolata* and other *Acremonium*-like fungi in order to characterize their natural habitats and their relationship to diseases in man and animals.

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A new species of *Exobasidium* (Exobasidiales) on *Rhododendron* from China

ZHENYING LI^{1,2} & LIN GUO^{1*}

lizheny@mails.gucas.ac.cn

**guol@sun.im.ac.cn*

¹Key laboratory of Systematic Mycology and Lichenology
Institute of Microbiology, Chinese Academy of Sciences
Beijing 100080, China

²Graduate University of Chinese Academy of Sciences
Beijing 100049, China

Abstract—A new species, *Exobasidium racemosum* causing shoot and leaves deformation on *Rhododendron racemosum*, is reported. The specimen was observed in Yunnan Province, China. In comparison with morphology based on macroscopical and microscopical structure of the validly described taxa on *Ericaceae* plants, this fungus differs from two similar species in the numbers of sterigmata and the mode of germination of basidiospores.

Key words—Ustilaginomycetes, symptom, taxonomy

A new species of *Exobasidium* on *Rhododendron racemosum* was collected from Lijiang, Yunnan Province in 2005. This species infects shoot and its clustered leaves, causing hypertrophy. The color of the infected parts is white and sometimes red. The transverse section of the diseased leaves shows hypertrophy of plant cells, but there is no differentiation between the palisade and mesophyll cells. Hyphae intercellular, protruding between epidermal cells in fascicles, forming a continuous layer on the undersurface of the leaves at maturity. In some microscopical slides of the fresh material, basidiospores germinate to conidia. The conidia can emerge from both ends and the septal regions of basidiospores. This recently collected *Exobasidium* species has (2-)3-7 sterigmata, and its basidiospores measure 9-15 x 3-4 µm. When comparing the morphology of the validly described taxa on *Ericaceae* plants, two species on *Rhododendron* show similarities in the sizes of sterigmata and basidiospores. The new species is different from *Exobasidium japonicum* Shirai (1896:52, Ezuka 1990:439) and *E. japonicum* var. *hypophyllum* Ezuka (1990:443) in the numbers of sterigmata and the mode of germination of basidiospores, the latter having only (2-)3-4(-5) sterigmata and germinating by germ tubes.

* Corresponding author

Exobasidium racemosum* Z.Y. Li & L. Guo, sp. nov.*Figs. 1-5**

Hymenium hypophyllum. Basidia hyalina, clavata vel cylindrica, 6-11 μm lata, terminaliter (2-)3-7 sterigmatibus 4-7 $\times$ 1-1.8 μm praedita. Basidiosporae clavatae, ellipsoideae vel curvae, 9-15 $\times$ 3-4 μm , hyalinae, laeves, primo continuae, dein 1-septatae, per conidia germinantes. Conidia bacilliformia vel clavata, 5-7 $\times$ 1.2-2 μm , hyalina, continua, laevia.

Hymenium hypophyllous, white. Basidia with (2-)3-7 sterigmata, clavate or cylindrical, 6-11 μm wide. Sterigmata, conical, 4-7 $\times$ 1-1.8 μm . Basidiospores clavate or ellipsoidal, 9-15 $\times$ 3-4 μm , hyaline, smooth, at first continuous, then 1-septate, slightly curved. Basidiospores germinate to produce conidia. Conidia bacilliform or clavate, 5-7 $\times$ 1.2-2 μm , hyaline, continuous, smooth.

On *Rhododendron racemosum* Franch. (Ericaceae), Yunnan: Lijiang, Yufengsi, alt. 2720 m, 17 IX 2005, Z.Y. Li, L. Guo & N. Liu 173, HMAS 140194 (holotype).

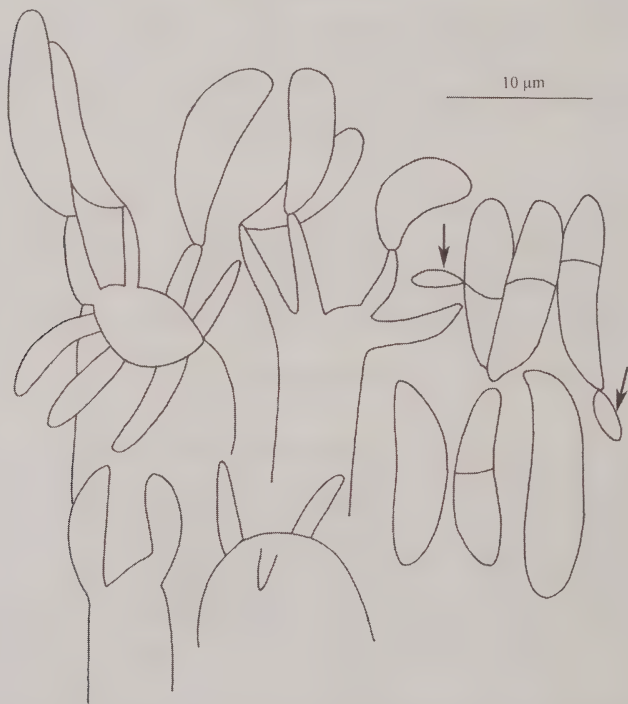


Fig. 1 (above). Basidia, sterigmata, basidiospores and conidia (arrows) of *Exobasidium racemosum* on *Rhododendron racemosum* (HMAS 140194, holotype).

Figs. 2-5 (to right). *Exobasidium racemosum* on *Rhododendron racemosum* (HMAS 140194, holotype). Fig. 2. Symptom. Fig. 3. Basidium, sterigmata and basidiospores as seen by LM (light microscopy). Figs. 4-5. Basidia, sterigmata and basidiospores as seen by SEM (scanning electron microscopy).



So far 18 species of *Exobasidium* have been reported in China (Tai 1979:454-456; Sawada 1922). Seven species are parasitic on *Rhododendron* plants: 1) *E. formosanum* Sawada causing leaf galls, 2) *E. hemisphaericum* Shirai causing leaf galls, 3) *E. japonicum* causing leaf hypertrophy and deformation, 4) *E. pentasporium* Shirai causing witches' broom, 5) *E. rhododendri* (Fuckel) C. E. Cramer causing leaf galls, 6) *E. taihokuense* Sawada causing leaf spots, 7) *E. racemosum* causing hypertrophy of the shoot and its clustered leaves (in this paper).

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Contribution to the study of *Endogonales* in Brazil: The first record of *Peridiospora tatachia*

BRUNO TOMIO GOTO & LEONOR COSTA MAIA

brunogoto@yahoo.com.br

leonorcmaia@yahoo.com.br

*Departamento de Micologia, CCB, Universidade Federal de Pernambuco
Av. Prof. Nelson Chaves s/n, Cidade Universitária, 50670-420, Recife, PE, Brasil*

Abstract—The order *Endogonales* contains four genera: *Endogone*, *Peridiospora*, *Sclerogone* and *Youngiomyces*. *Peridiospora* is the only genus with unispored sporocarps, which are quite similar to certain spores of *Glomeromycota*. In Brazil, there are few collections of the *Endogonales*; it is possible that species of this order are found, but not identified due to the lack of information regarding the group in most tropical countries. The occurrence of *Peridiospora tatachia* is recorded from Brazil, the species description is emended, and characters are discussed that help distinguish *P. tatachia* from similar species of *Glomeraceae* and *Acaulosporaceae*.

Key Words—diversity, *Endogonaceae*, *Glomus*, morphology

Introduction

The genus *Endogone*, characterized by production of sporocarps and zygospores, and formation of ectomycorrhiza, was included in *Endogonales* (Gerdemann & Trappe 1974). *Endogone* was retained in the *Endogonales* when the endomycorrhizal members of this order were transferred to the *Glomerales* (Morton & Benny 1990).

Warcup (1990) proposed the genus *Sclerogone* for *Endogonales* with small sclerotoid sporocarps. Later, Yao et al. (1995) added the genus *Youngiomyces*. The members of this genus produce two, three, or even four gametangia that do not contact one another, whereas in *Endogone* and *Sclerogone* two gametangia contacting one another along their entire length are produced. Wu & Lin (1997) proposed a new genus, *Peridiospora*, with sporocarps containing only one zygospore, with a pair of gametangia. Currently, the *Endogonales* contain four genera: *Endogone*, *Peridiospora*, *Sclerogone* and *Youngiomyces*.

In spite of the distinct modes of reproduction — sexual in *Endogonales* (Zygomycota) versus asexual in *Glomeromycota* (Schußler et al. 2001) — their representatives can be confused due to similarities between spores and sporocarps.

Peridiospora can be easily mistaken for some members of *Glomeromycota* because of the hyaline hyphal net (mantle) that covers the spore. For this reason, morphological

characters that distinguish *Endogonales* (*Peridiospora*) from *Glomerales* (*Glomus*) and *Diversisporales* (*Entrophospora*) will be discussed.

There are few records of *Endogonales* in Brazil, probably due to a lack of knowledge regarding the members of this order; *Endogone lignicola* Pat., *E. fulva* (Berk. & Broome) Pat., *E. malleola* Harkn. and *E. reniformis* Bres. currently are known. These collections were made by Batista and co-workers (Silva & Minter 1995) and Thaxter (1922). Two species of *Endogone*, *E. malleola* and *E. reniformis*, were transferred to *Modicella* (*Mortierellales*) by Gerdemann & Trappe (1974). The objectives of this paper are to document the occurrence of *P. tatchia* in Brazil, and to enhance the description of the species with morphological data that can aid in the identification of members of *Endogonales* that are known to occur in Brazil.

Material and methods

Soil samples were collected (0 to 20 cm deep), in an area cultivated with *Passiflora alata* Curtis (passion fruit) in Limoeiro, Pernambuco State, northeast Brazil. Spores of AMF were extracted from soil by wet sieving (Gerdemann & Nicolson 1963) and sucrose centrifugation (Jenkins 1964), separated and mounted in PVLG (polyvinyl lactoglycerol) or PVLG + Melzer reagent (Schenck & Pérez 1990). For the species description the terminology proposed by Morton (<http://invam.caf.wvu.edu>) was adopted.

Taxonomy

Peridiospora tatchia C.G. Wu & Suh J. Lin, Mycotaxon 64: 181, 1997. Figs. 1, 2.

Unizygosporocarps formed are globose to subglobose, 223–230 µm in diam, or rarely irregular, 208 x 197 µm, red-brown to dark brown in color. Mantle thick, 6.0–9.6 µm, formed by hyaline, interwoven hyphae with a thin wall < 1.0 µm, zygosporocarp covered with a homogeneous layer. Zygosporocarp wall formed by a unit layer, red brown to dark brown in color, 4.8–6.0 µm thick. Zygospore wall with a membranous hyaline layer < 1.0 µm usually rough and readily separated from the zygosporocarpic wall. Gametangia yellow brown, with a thin wall, < 2.4 µm, similar to the sporiferous saccule of members of the *Acaulosporaceae* (Glomeromycota). Insertion point usually globose, 21.6 µm in diam, forming a scar similar to that observed in the latter family.

Examined material: Brazil, Pernambuco State: Municipality of Limoeiro, in the rhizosphere of *Passiflora alata*, Anjos URM 45719. Nam-Tou, Yusan National Park, Taiwan, isotype FL 56217 from the rhizosphere of *Pieris taiwanensis*.

Distribution and habitat: Spores found in areas of natural forests in Nam-Tou, Yu-san National Park (Taiwan) and in an agricultural area in northeast Brazil.

Discussion

Peridiospora tatchia can be mistaken for *Entrophospora baltica* Blaszk. et al., *Glomus globiferum* Koske & C. Walker, *G. mosseae* (T.H. Nicolson & Gerd.) Gerd. & Trappe, *G. mortonii* Bentiv. & Hetrick and *G. tortuosum* N.C. Schenck & G.S. Sm. due to the presence of a net of hyaline hypha that covers the spore. However, *E. baltica* produces a spore wall consisting of five layers (Błaszkowski et al. 1998a) while *P. tatchia* has only two wall layers, one arising from the zygosporocarp and the other from the zygospore.

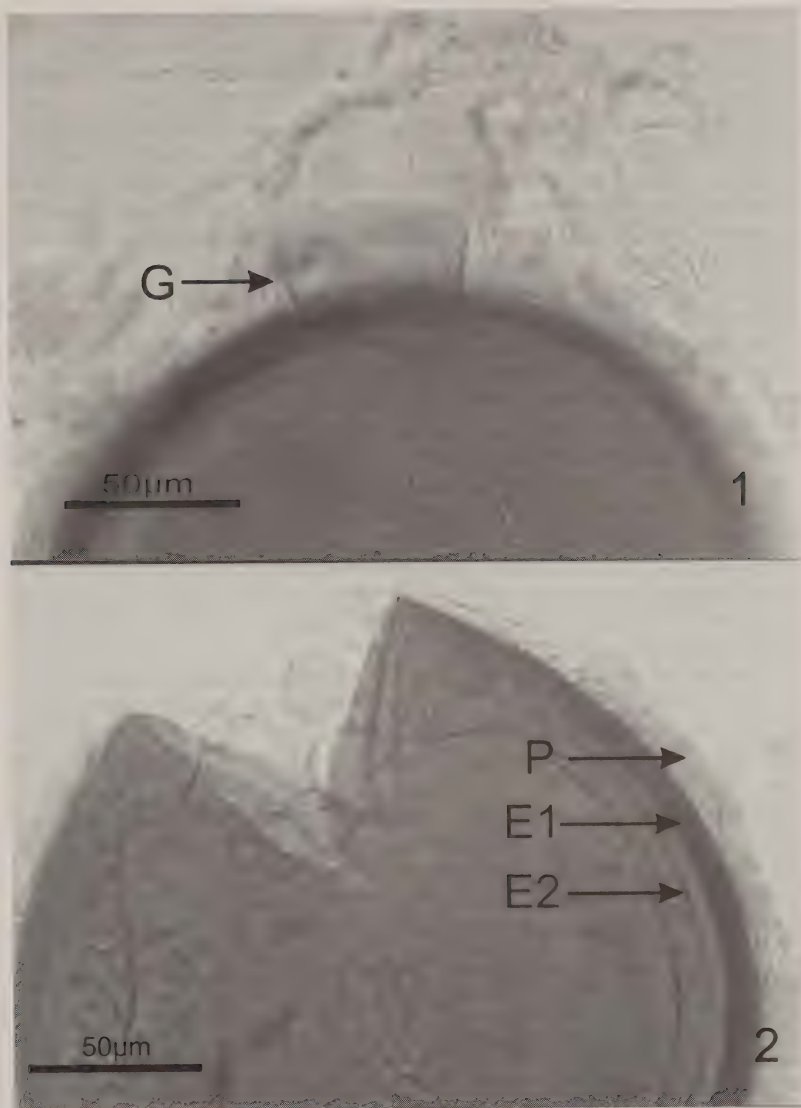


Figure 1-2. *Peridiospora tatachia*. 1- Details of an ephemeral gametangium (G) attached to the zygospore; 2- Detail of the spore wall with mantle surrounding the spore (P), exospore (E1) and endospore (E2).

Moreover, the spore wall in *E. baltica* is ornamented, while the spores of *P. tatchia* have a smooth wall. *Peridiospora tatchia* also has a membranous inner wall layer (endospore) while the species of *Glomus* with a mantle, such as those mentioned above, do not have this structure.

Peridiospora tatchia can also be confused with *Endogone maritima* Błaszk. et al., since both species have gametangia, a mantle covering the spore and an inner wall layer (endospore). However, *E. maritima* forms multispored sporocarps, while in *P. tatchia* these are unispored. It is difficult to distinguish between the latter two taxa when single zygospores of *E. maritima* are found isolated in the soil (Błaszkowski et al. 1998b). Wu & Lin (1997) interpreted the reproductive structure of *Peridiospora* as an unispored sporocarp and not as a spore covered by a mantle, and described the genus based on this character.

The morphological characters used for identification of species of *Endogonales* are the same ones that are used for Glomeromycota since the basis for the study of both groups comes from the review of Gerdemann & Trappe (1974). For this reason, determining members of both groups sometimes can be difficult.

The first character that must be observed in order to distinguish members of *Endogonales* from *Glomerales* (Glomeromycota) is the presence of two or more gametangia and spores with a thick inner wall layer (endospore). Some *Glomus* species, however, have spores with an inner wall layer. Such spores are asexually formed and connected by a single suspensor hypha and not by the union of two gametangia as in *Endogonales*. Recently, the species of *Glomus* with an inner spore wall layer were transferred to the genus *Pacispora*, and they do not have a mantle covering the spores (Oehl & Sieverding 2004).

The gametangium in species of *Endogonales* is ephemeral and probably detached during extraction of spores from soil, using the same technique employed for extraction of spores of arbuscular mycorrhizal fungi (AMF). Thus, only the remnants of the gametangia or the scar left at the attachment site can be found on the zygospores. This scar is similar to the one left at the insertion of the sporiferous saccule in species of *Acaulosporaceae* (*Acaulospora* and *Entrophospora*). Spores of *Glomeraceae* do not have a discrete scar such as that observed in *P. tatchia*, or two scars as those produced by *Entrophospora*; this characteristic is strong evidence for identification of these fungi.

In *Peridiospora* the zygosporangial wall is continuous with the gametangial wall, a condition similar to that observed in species of *Glomus*. The supporting hypha produced by *Glomus*, however, is more stable than that found in *Peridiospora*. This structure is not lost at spore maturity as it is in *Entrophospora colombiana* Spain & N.C. Schenck (Morton 1988).

In the majority of species of *Entrophospora*, the external spore wall layer is continuous with the sporiferous saccule; however, this wall layer is ephemeral in *E. colombiana*, and it is lost at maturity (Stürmer & Morton 1999). In *P. tatchia* the external wall (exospore) is continuous with the gametangial wall.

To accurately identify members of *Peridiospora* one needs to observe the Melzer reaction of the hyphal net covering the spores, the external wall (exospore) that is separated from the inner wall (endospore) and the presence of gametangia. When the latter structures are not discrete, one should look for the scars of the gametangia, and the absence of numerous layers of the inner wall as occurs in species of *Acaulosporaceae*.

The description of the genus *Peridiospora* (Wu & Lin, 1997) should be revised. The character that separates *P. tatchia* and *P. reticulata* C.G. Wu & Suh J. Lin from *Endogone* is sporogenesis, a characteristic also used to define *E. maritima*. *Peridiospora* is unizygosporocarpic, which differs from the typical multispored sporocarps of *Endogone* (Wu & Lin 1997). However, when describing *E. maritima*, Błaskowski et al. (1998b) observed that the zygosporangia could be found both in a multispored sporocarp or as single zygosporangia isolated in the soil. Such zygosporangia are similar to those of *P. tatchia*, but in *E. maritima* the sporocarps are multispored, while in *P. tatchia* they are unispored. It is possible that *P. tatchia* produces multispored sporocarps but they were not observed in the samples from the field and that the technique used to extract spores may have disrupted the sporocarp structure.

A detailed study of the type material of *P. tatchia*, *P. reticulata* and *E. maritima* would be useful in elucidating the sporocarpic nature of these species and to determine if *P. tatchia* and *P. reticulata* constitute a genus separate from *Endogone*. Although molecular data are available, the phylogenetic position of *Endogonales* is still unclear (Tehler et al. 2003). Additional molecular studies might resolve the phylogeny of the latter order of the Zygomycota and its relationship to the Glomeromycota (Tanabe et al. 2005).

Key to distinguish species of Glomeromycota (with mantle) from species of *Peridiospora* found in Brazil

- 1a. Spore globose with a hyaline mantle and a glomoid attachment hypha 2
- 1b. Spore globose with a hyaline mantle, without a glomoid attachment hypha and usually having a gametangium or sporiferous saccule remnants 5
- 2a. Mantle ephemeral or facultative, hyphal attachment funnel shaped
. *Glomus mosseae*
- 2b. Mantle persistent, attachment hypha not funnel shaped 3
- 3a. Mantle forming vesicles on the spore surface *Glomus globiferum*
- 3b. Mantle without vesicles on the spore surface 4
- 4a. Spore wall with only one laminated wall layer *Glomus tortuosum*
- 4b. Spore wall with two laminated wall layers *Glomus mortonii*
- 5a. Spores showing a scar and two wall layers *Peridiospora tatchia*
- 5b. Spore showing two scars and five wall layers *Entrophospora baltica*

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Thanks to: Érika dos Anjos for providing the soil samples for this study, Drs. Gladstone Alves da Silva and Sandra F. B. Trufem for suggestions, Dr. Reginaldo Silva for helping with the pictures. The authors also acknowledge, in special, Dr. Gerald Benny and Dr. Chi-Guang Wu, for reviewing the manuscript and making helpful comments and suggestions. This work was supported by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) that provided, respectively, a research grant to Leonor C. Maia and a PhD scholarship to Bruno T. Goto.

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MYCOTAXON

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BOOK REVIEWS AND NOTICES

Compiled by

DAVID L. HAWKSWORTH¹

*MycoNova, The Yellow House, Calle Aguila 12, Colonia La Maliciosa
Mataelpino, ES-28492 Madrid, Spain*

General

Fungi Down Under: the Fungimap Guide to Australian Fungi. By Pat Grey & Ed Grey. 2005. Fungimap, c/o Royal Botanic Gardens Melbourne, Private Bag 2000, South Yarra, VIC 3141, Australia (e-mail: fungimap@rbg.vic.gov.au). Pp. iv + 146. ISBN 0 646 44674 6. Price: AS\$ 29.95.

Starting with a Foreword by John Landy, Governor of Victoria, this is a beautifully presented guide that should do much to popularize field mycology in Australia – and be purchased by all mycologists making side-trips around the Eighth International Mycological Congress (IMC8) in Cairns this August. Fungimap aims to map 100 selected species throughout Australia, which could be reliably identified by the naked eye. By the time this work went to press in 2005, the number of records exceeded 20 000 and had these had been contributed by over 300 field mycologists. This book presents those 100 target species. Following information on collecting and the recognition of different groups, with beautiful coloured illustrations and a splendid “visual key”, each species has a full page. That page includes the common and scientific name (uncluttered by any confusing author citations, which are relegated to an Appendix), bold-face notes on habitat and recognition, coloured illustration(s), description, notes, warnings of “look-alikes” (often also illustrated), and the distribution maps. Some of the maps have Australia pretty-well spotted, such as Black Powderpuff (*Podaxis pistillaris*) with 119 records, while others show species have very restricted areas as with Gold Tufts (*Cryptotrama aspratrum*) in the south-eastern provinces and Tasmania, and others such as the Two-toned Pin (*Chlorovibrissea bicolor*) are only still known from a single site. That clear biogeographical patterns are emerging shows just how successful a targeted mapping scheme can be. Also provided in Appendices is information on alternative

¹Books for consideration for coverage in this column should be mailed to the Book Review Editor (address above) in the first instance. Fax (+34) 91 857 3640; e-mail: myconova@terra.es.

names (especially those in a CD-ROM Fungimap issued in 2001), etymology, and pronunciation, together with an extensive reference list including other Australian field guides. The inside back cover has a colour chart with 190 shades. The whole initiative has been very much a collaborative effort, with the Acknowledgements filling two pages, and the results presented here provide a model that merits emulation in other countries – serving to simultaneously stimulate public interest in fungi and advance our understanding of their ecology and distribution.

Lista de Especies Silvestres de Canarias (Hongos, Plantas y Animales Terrestres) 2004. Edited by Isaac Izquierdo Zamora, José Luis Martín Esquivel, Nieves Zunita Pérez & Manuel Arcechavaleta Hernández. 2004. Dirección General del Medio Natural, Consejería de Medio Ambiente y Ordenación Territorial, Gobierno de Canarias, Centro de Planificación Ambiental, Ctra La Esperanza km 0.8, 38071 La Laguna, S/C Tenerife, Canary Islands. Pp. 500. ISBN 84 89729 23 9. Price: Free at the discretion of the publisher.

This is a remarkable output from the Banco de Datos de Biodiversidad de Canarias, established in 1999. Essentially it is a checklist covering all groups of organisms apart from algae, bacterial groups, and protozoans recorded from the forests of the seven islands that make up the Canary Islands. The entries for the diverse taxa follow a standard format and are arranged by taxonomic group down to family, species then being listed alphabetically. For each taxon there is an indication of whether it is native, probably native, invasive or endemic (a remarkable number of genera as well of species of plants and insects are) and the islands on which they occur. Alternate species entries are back-tinted making the whole easy to read and pleasant on the eye. Author citations of species names are included, and dates of publication for the zoological entries — a practice increasingly being used in fungal checklists, but sadly not copied here in the fungal and plant lists. After the systematic treatment there is a single alphabetical index to all organisms covered along with cross-referenced synonyms.

The non-lichenized fungal entries were overseen by Esperanza Beltrán Tejera, and those for lichens and lichenicolous fungi by Consuelo E. Hernández-Padrón. Inputs were provided by numerous specialists including André Aptroot, Hans-Otto Baral, Uwe Braun, Javier Etayo, Josef Hafellner, Paul M. Kirk, Richard P. Korf, and Leif Ryvarden.

My only disappointment was to see *Oomycota* and *Myxomycota* treated as *Fungi*, to see a totally separate section *Lichenes*, and to have an entry *Fungi Imperfecti* under both *Fungi* and *Lichenes*.

The whole is hardbound and beautifully presented, and only in Spain could such a work be made available free of charge (at the discretion of the publisher) while stocks remain.

Atlas of the Geographical Distribution of Fungi in Poland. Fascicle 3. Edited by Władysław Wojewoda. 2005. W. Szafer Institute of Botany, Polish Academy of Sciences, Lubicz 46, PL-31 512 Kraków, Poland (e-mail: ed-office@ib-pan.krakow.pl). Pp. 145, maps. ISBN 83 89648 27 X. Price: 30 €.

This is the third and largest fascicle of this *Atlas* to have appeared², and follows the same format with information on nomenclature, general remarks on the species, details of localities and literature sources, and dot-maps with records separated into different date categories. Each map is individually authored. Thirty species are treated in this part and come from a wide range of genera: *Amylocystis*, *Antrodia*, *Biscogniauxia*, *Botryobasidium*, *Clavaria*, *Coniophora*, *Entoloma*, *Hapalopilus*, *Helicobasidium*, *Hericium*, *Hygrocybe*, *Inocybe*, *Leucogyrophana*, *Lycoperdon*, *Mycenella*, *Oligoporus*, *Onygena*, *Phylloporus*, *Sarcosoma*, *Sarcosphaera*, *Skeletocutis*, *Suillus*, *Tricholoma*, *Veluticeps*, and *Xerula*. Conservationists may wish to note those of *Hericium erinaceum* and *Hygrocybe calyptriformis*, both of which prove to be exceptionally rare and local in the country.

Microfungi of the Tatra National Park: A checklist. By Wiesław Mułenko, Monika Kozłowska & Bogusław Sałata. 2004. W. Szafer Institute of Botany, Polish Academy of Sciences, Lubicz 46, PL-31 512 Kraków, Poland (e-mail: ed-office@ib-pan.krakow.pl). [Biodiversity of the Tatra National Park Vol. 1.] Pp. 72. ISBN 83 89648 15 6. Price: 25 €.

To find the first number in a series of volumes on the biodiversity of a region devoted to fungi, and not to birds, mammals, or plants, is a welcome surprise. This checklist of the Tatra National Park, which is recognized as a UNESCO Biosphere Reserve, covers ascomycetes and their anamorphs, chromistan fungi, chytrids, rusts, smuts, and zygomycetes. In all, 509 “microfungi” have been recorded in an area with 345 plant species – a commendable total based on a combination of published reports and material collected by the authors over the last 20 years (preserved in LBLM, Lublin).

The species are arranged alphabetically within orders, with information on the region they came from, the altitude, and information source presented in a neat columnar layout. There are also cross-indices to the placement of genera, and a synopsis of the species recorded from different host plants. The latter reveals that there is still much to be done as, for example, only four species are reported on *Pinus* and three on *Rubus*. On the other hand, the coverage of rusts, smuts and leaf-inhabiting fungi is quite impressive, with, for example, 30 species of *Septoria* and 60 of *Puccinia* – reflecting the interests of particular mycologists.

The book is well presented and has clearly been carefully compiled, and will certainly be a stimulus to further recording in this important site.

²Fascicle 1 (2000) is reviewed in *Mycotaxon* 82: 477 (2002); and Fascicle 2 (2002) is reviewed in *Mycotaxon* 89: 212 (2004).

Basidiomycetes

Röhrlinge und Blätterpilze in Europa. By Egon Horak. 2005. Elsevier Spektrum Akademischer Verlag, Verlagsbereich Biologie, Chemie und Geowissenschaften, Dr Ulrich G. Moltmann, Slegotsrasse 3-5, D-69126 Heidelberg, Germany (e-mail: info@s-f-g.com). Pp. xvii + 555, plates 4. ISBN 3 8274 1478 4. Price: 40 €.

This is essentially sixth edition of the late (1924-2002) Meinhard Michael Moser's classic keys to European agarics (*s. lat.*) and some polypores, *Die Röhrlinge und Blätterpilze*, originally published in 1953 as the second volume of the *Kleine Kryptogamenflora* of which Helmut Gams (1893-1976)³ was the inspiration and editor. The idea was to produce compact keys including as many species as possible, suitable for use on field excursions. Moser had evidently been thinking about a revision before his sudden death, and who better to take up the challenge than his ex-student Egon Horak who had been so close to him for many years!

After the briefest of introductions as to how to use the keys, make spore-prints, macro- and microscopical examination, reagent tests, and a glossary, there are explanations of symbols, literature abbreviations, and author abbreviations that are all contained in a mere 20 pages, the keys commence in earnest. I did not count the species treated, but there must be close to 3000 – an extraordinary task which it takes someone of Egon's depth and breadth of knowledge to be able to even contemplate. The system of numbering subkeys may at first seem cumbersome and take some time to get accustomed to but seems logical and to work even in back-tracking.

Where species are keyed out, supplementary information is presented on microscopical and other features, ecology and some synonyms, but distributional information is sparse and comments like "Selten" might have been amplified. The codes going straight to journal and book actual page references are invaluable and working with the book the main ones will quickly become lodged in the user's little grey cells.

I am sure that in such a huge and complicated work, there are bound to be the odd mistakes, and a short slip of "Errata" was included with the review copy. However, I was surprised still to see *Coprinus* being used inclusive of the segregate genera and not even with new placements given as synonyms. But then, perhaps the work was already too advanced by the time the Committee for Fungi pronounced on the issue.

Although entirely in German, as a well-known failed linguist (a reaction in my school days to a father who taught and knew seven languages) I could cope, so do not let the language put you off!

This is a *must* for all field mycologists world-wide, and I am sure that Moser would have been proud at this achievement of his pupil.

Checklist of the British and Irish Basidiomycota. By N.W. Legon & A. Henrici, with P.J. Roberts, B.M. Spooner and R. Watling. 2005. Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AB, UK (e-mail: publishing@kew.org). Pp. 517. ISBN 1 84246 121 4. Price £ 29.00.

³Father of K. Walter Gams.

This work, the size of a small telephone directory, updates the classic *New Check List of British Agarics and Boleti*, published by Dennis, Orton and Hora in 1960. However, it is much more than a new version of the *New Check List*, for it covers all the *Basidiomycota*, including agarics, boletes, polypores, puffballs, stinkhorns, false truffles, coral fungi, hydroid fungi, cyphelloid fungi, rust fungi, smut fungi, and jelly fungi (often with yeast phases). A total of 3671 species and infraspecific taxa are accepted. Genera have sensibly been listed alphabetically within classes, rather than within orders or families, the composition of which is rather fluid at present. The disposition of genera in higher taxa is provided under the generic headings (albeit from the 8th rather than the 9th edition of the *Dictionary of the Fungi*).

For the user interested in the current names of British and Irish *Basidiomycota*, and where and on what they are found, the *Checklist* will be an invaluable resource. For each species, frequency of occurrence is indicated for England, Scotland, Wales, Northern Ireland, the Republic of Ireland, the Isle of Man, and the Channel Islands. There is also a concise list of descriptions and illustrations. At the end of each entry there are brief additional comments, mainly about distribution and vouchers. The checklist style is necessarily terse, but there are some fascinating snippets of information, such as that the typically coastal *Agaricus bernardii* is “spreading due to the de-icing of roads with salt”, and that *Nia vibrissa* has been “collected from the timbers of Henry VIII’s flagship ‘Mary Rose.’”

There is a complete index of taxa. Provision of a running head with generic names would facilitate finding entries when thumbing through the work, but otherwise the text is clearly presented. However, certain features of the layout seem to be derived from the structure of the electronic database from which the text was produced, and can be somewhat disconcerting. Colons are used before page numbers, whether or not there is a volume number. References to homonyms appear in square brackets in the middle of the citation of name. I could not discern why part numbers are provided for some journals (such as *Mycological Research*) but not others (such as *Grevillea*).

Classification

The classification adopted, as far as the limits of and accepted names for genera, is on the whole very modern. There are numerous changes from the genera as conceived in the *New Check List*, such as the adoption among the agarics of *Ampulloclitocybe clavipes*, *Arrhenia* (for species such as *A. griseopallida*, formerly in *Omphalina*), *Contumyces rosellus*, *Lichenomphalia* (for the lichenised species formerly in *Omphalina*), *Loreleia* (for *Gerronema postii* and allies), *Neolentinus* (for *Panus lepideus* and allies), *Sphagnomphalia brevibasidiata*, and *Tapinella* (for the wood-inhabiting species formerly in *Paxillus*). Similarly, amongst the corticioid fungi, there is *Hypochniciellum* (for *Leucogyrophana mollis* and allies) and *Terana* (for *Pulcherricium*), and among the jelly fungi, *Serendipita* (for *Sebacina vermifera* and allies). The work is thus a very useful snapshot of the current classification of *Basidiomycota*, fleshing out the tables of genera in families of the *Dictionary of the Fungi* by the presentation of lists of species under each genus.

Given the general adoption of up-to-date generic concepts, it is disconcerting to see a couple of glaring anomalies, particularly for *Collybia* and *Coprinus*. Other taxonomic decisions that are rather conservative are retention of *Junghuhnia*, some of which are

stated to be ‘microscopically indistinguishable’ from *Steccherinum*, the continued separation of *Schizopora* from *Hyphodontia*, and retention in *Macrolepiota* of species better placed in *Chlorophyllum* (such as *C. rachodes*).

Coprinus is retained in the broad sense. The segregate genera *Coprinellus*, *Coprinopsis* and *Parasola* are listed as synonyms of *Coprinus*, but under each species of this genus no combinations are provided in the segregates, so it is impossible to follow the widely accepted re-classification proposed by Redhead *et al.* (2001). It is not clear if retention of *Coprinus* in the broad sense is due to disagreement about the fundamental separation of *Coprinus comatus* and allies from the rest of the genus, or to perceived problems with the limits of the segregate genera (and perhaps their differentiation from *Psathyrella*). The genus *Collybia* is also retained in a very broad sense, even though the type (*Collybia tuberosa*) and a few other species seem quite different from the rest of the species in the genus. The attempt at redefining generic boundaries by Antonin *et al.* (1997), with adoption of *Rhodocollybia* and *Gymnopus* and sinking of *Micromphale*, seems a reasonable approach, despite the very confusing story arising from current molecular data, as does adoption of *Dendrocollybia* for *Collybia racemosa*. For *Coprinus* and *Collybia*, at the very least, a short statement should have been given under each genus alerting users to alternative classifications and the authors’ reasons for not adopting them, and indicating that use of the genera in a wide sense is untenable, and changes are inevitable. This kind of taxonomic metadata should be included in checklists wherever possible.

Excluded taxa

The main listing (in three sections for *Basidiomycetes*, *Urediniomycetes* and *Ustilaginomycetes*) is followed by lists of alien taxa and excluded taxa. Readers should keep in mind that the alien list is restricted to species known only in the British Isles from an indoor environment, so that other fungi that could rightly be regarded as aliens are in the main listing, such as the obligate *Eucalyptus* associate, *Hydnangium carneum*.

The listing of excluded taxa is very useful in removing from the main section many dubious species and incorrect records. Excluded taxa fall into two groups. There are those whose type locality is Britain or Ireland and which are *nomina dubia*, and those originally described from elsewhere which have been erroneously reported from Britain or Ireland. For the *nomina dubia*, the listing is informative in disposing of numerous names of uncertain application from the 18th and 19th century literature, such as among those introduced by Berkeley, Bolton, Cooke, Dickson, Hudson, Massee, Sowerby and Withering (although of course many of their other species are accepted). For names that are excluded because they are incorrectly recorded, the comments are often quite telegraphic in style, and it would have been useful to have more information about the source of the erroneous records. There are statements along the lines of “reported from England” without an indication of by whom, and whether as a specimen, literature or foray record. Nevertheless, it is always useful to have as many of these erroneous records cleaned out from checklists, and it certainly seems that some effort has gone into this.

Citations

A checklist in its simplest form is a list of accepted names, without citations or synonyms, which serves those using the names for whatever purpose, whether carrying out research

on particular species, constructing a list of rare and endangered species, compiling an inventory of the fungi from a particular area, or publishing a field guide. For all users, the *British & Irish Checklist* presents the accepted names in a clear fashion, and many users will want no more than this.

However, this work is much more than a mere checklist, because it will be a first choice as a reliable source of author and publication details, as well as of synonymy. This is because it is apparent that great care has been taken in getting names and their citations right under the current *Code*, and also because there is no other single source for the citations of so many names for this region (and indeed there are few similar listings for other regions with a comparable level of detail and scholarship).

For each name, the citation of author and publication details — in terms of abbreviations and presentation of data, often from multivolume works with complex datings — is on the whole exemplary. The one exception is the new names introduced by Schaeffer in the four volume *Fungorum qui in Bavaria et Palatinatu ... nascuntur icones*. These names are credited to earlier volumes, such as the first (published in 1762), where only informal names are used, rather than correctly to the fourth volume of 1774, where Latin binomials are provided, with cross references to the earlier text and plates (Petersen 1976). This could lead to erroneous decisions about the accepted name, which has certainly occurred for *Amanita citrina*. This is based on *Agaricus citrinus* Schaeff. 1774 non Gunnerus 1772. Due to the homonym, priority for *citrinus* dates from 1797 when the name was used by Persoon in *Amanita* (as a *nomen novum*). Consequently *Amanita citrina* is correctly known as *A. mappa*, based on *Agaricus mappa* Batsch 1783, as has already been pointed out by Rauschert (1992).

Names have been updated in respect of the change in starting point date introduced at the Sydney Congress. In particular, this has been done in accord with removal of the vexatious necessity to include the first author on or after 1 Jan. 1821 to have used names introduced previous to that. This means that very obscure works such as St Amans' *Flore Agenaise* disappear from citations, replaced by direct citation of the original publication, as for *A. porphyria* Alb. & Schwein. and *A. rubescens* Pers. Readers will also find reference to recombining authors from important, but hitherto overlooked, works such as Lamarck's *Encyclopédie* from 1783 on, as for *Amanita muscaria* (L.) Lam. Provision of these corrected citations is a very welcome component of the 2005 *Checklist*.

Synonymy

Just as the citations are of great value, so too are the synonymies, which include misidentifications. The *Checklist* will be useful in presenting the "story" that a synonymy entails, again because there is no other completely reliable source covering so many names. For this reason it is unfortunate that in the lists of synonyms, apart from for the accepted name, many basionyms are omitted, presumably because they have not been used for British or Irish records. This makes it impossible to understand why some names have been adopted, because part of the "story" is missing (such as knowledge for competing synonyms of their date of introduction and the rank at which they were introduced). Furthermore, the compilers note that ideally the source of synonymy should be included, but this was a 'major additional level of research'. This is all too true, but this kind of taxonomic metadata does need to be documented, as do alternate synonymies.

Those synonyms that are included, covering all names applied in literature pertaining to the British Isles, are listed in groups of homotypic synonyms ordered alphabetically by the epithet of the basionym. Thus the oldest synonym may come at the end of the list, as under *Micromphale foetidum* where *Agaricus venosus* Pers. 1801 is after *Marasmius rufocarneus* Velen. 1920.

The combination of not including all the basionyms and not listing groups of homotypic synonyms by date order of the basionym can lead to erroneous choice of accepted name because the full information on which to assess the correctness of the accepted name is not always available. This seems to have happened very rarely, but one example is *Hygrocybe persistens*. According to the information presented, this is based on an epithet initially introduced at varietal rank and seemingly not raised to species rank until 1940, and therefore the correct name is *H. acuticonica*. Even when some combinations omitted from the synonymy (such as *Hygrophorus persistens* (Britzelm.) Britzelm.) are considered, the correct name remains *Hygrocybe acuticonica*, as demonstrated by Cantrell & Lodge (2000).

To be fair to the authors, it was perhaps not their intention to provide the full “story” in terms of synonymy, but frustratingly (particularly for agarics), complete synonymy along with rigorous citations are not available en masse anywhere else, even on-line.

Sanctioned names

The sanctioning author is an important kind of nomenclatural metadata that has been omitted; metadata that enables understanding of why certain choices have been made in determining the correct name under the prevailing *Code*. For sanctioning, the reader is merely referred to the compilation by Gams (1984). As with the lack of basionyms, in numerous cases it is not possible to understand why the accepted name has been chosen without an indication of which names are based on sanctioned epithets. Often there are several competing epithets, the earliest of which has not been adopted presumably because it was not sanctioned, whereas the epithet of the accepted name was sanctioned. Mostly the right choice seems to have been made, it is just not possible to follow why. However, in at least a few cases the correct epithet has not been adopted, such as for *Neolentinus lepideus*, which is sanctioned; but so is the synonym *Agaricus suffrutescens*, which is based on an earlier basionym, and therefore the name to be adopted. It is true that few others have adopted the nomenclaturally correct name, and *Neolentinus lepideus* seems a good candidate for conservation. However, the point remains that the logic behind adoption of names cannot always be discerned without knowing which epithets are sanctioned.

The method of indicating sanctioning recommended in the *Code*, by use of “: Fr.” or “: Pers.”, travelling along with the original author of sanctioned epithets, can indeed be cumbersome and in certain cases potentially misleading (where the epithet was sanctioned at a different rank to competing non-sanctioned synonyms). In addition sanctioning itself and “: Fr.” citations are generally a complete mystery to non-mycologists, and quite confusing to compilers and users of general biodiversity and herbarium databases. If such an authoritative work as this *Checklist* chooses to ignore sanctioning, perhaps it is time to reconsider how to present this very important aspect of fungal nomenclature. The simplest way to designate sanctioning in a list of synonyms

is to include the phrase “sanctioned name” after particular names in the form they appeared in the sanctioning works, and not to carry this designation with epithets when they are transferred to other genera, in much the same way that “conserved name” can be included after a name where relevant.

Nomenclature

Apart from the omission of reference to sanctioning, names are presented in accord with current rules of nomenclature throughout. There is one glaring exception, concerning the spelling of the genus *Battarrea*, for which the form *Battarraea* has been adopted. Correction from the original “*Batarrea*” is allowed under the *Code*, because it relates to misspelling of the name of the person commemorated (Battarra), but there is no mandate to correct the termination. A proposal to conserve the spelling “*Battarraea*” was rejected (Korf 1988), and there the matter should rest (with spelling as *Battarraea*). This case is by no means trivial because the fungus is rare in England, and could well be included in RED data lists, or listings under government legislation, for which changes in spelling would be at least inconvenient if not disruptive. Stability of taxonomic concepts of genera is a long way off, but stability of the nomenclatural aspects of spelling, citation and choice of accepted names should be possible in the context of the currently accepted taxonomic arrangement. It is not clear if the earlier decision to reject conservation of *Battarraea* has been overlooked, or if there was a compelling reason to go against it. This is another situation where including the nomenclatural metadata would be useful. There should be no need to re-visit old cases, like some cold-case detective, only to find that they were successfully closed many years ago.

Database

The work is derived from a database at the Royal Botanic Gardens Kew “designed by J.A. Cooper and supported by P.M. Kirk”. According to the website of the Royal Botanic Gardens Kew (www.kew.org; accessed May 2006) “The checklist is ... being maintained as an actively updated database available for consultation through the internet. Work is in progress to make this online database operational as soon as possible”. Apparently the printed *Checklist* is just a snapshot of the data in the database. Therefore, there is a great opportunity when the database goes on line to include the wish list of taxonomic and nomenclatural metadata mentioned above. Whether a fuller set of data is made available in printed form in due course, or whether the on-line version completely replaces text will be an interesting development to watch over the next few decades.

Conclusion

The *Checklist of British and Irish Basidiomycota* represents a mammoth amount of painstaking research, and will be the standard reference list for anyone dealing with British and Irish *Basidiomycota*. The volume is also very useful for workers in other regions, given that many British and Irish basidiomycetes are common elsewhere. The *Checklist* is aimed at “wildlife recorders and conservationists” as well as ‘amateur and professional mycologists’ and all these users will find it invaluable.

Antonín V, Halling RE, Noordeloos ME. (1997) Generic concepts within the groups of *Marasmius* and *Collybia* sensu lato. *Mycotaxon* 63: 359-368.

- Cantrell SA, Lodge DJ. (2000) *Hygrophoraceae* of the Greater Antilles: *Hygrocybe* subgenus *Hygrocybe*. *Mycological Research* **104**:873-878.
- Gams W. (1984) An index to fungal names and epithets sanctioned by Persoon and Fries. *Mycotaxon* **19**: 219-270.
- Korf RP. (1988) Report (n.s. 1) of the Committee for Fungi and Lichens on proposals to conserve and/or reject names. *Taxon* **37**: 450-463.
- Petersen RH. (1976) An annotated index for J.C. Schaeffer's "Bavarian Fungi". *Mycotaxon* **4**: 145-154.
- Rauschert S. (1992) Nomenklatorische Studien bei Höheren Pilzen. V. Agaricales (Blätterpilze unter Ausschluss der Täublinge und Milchlinge). *Nova Hedwigia* **54**: 213-228.
- Redhead, S.A., Vilgalys, R., Moncalvo, J.-M., Johnson, J. & Hopple, S. Jnr. (2001), *Coprinus* Pers. and the disposition of *Coprinus* species sensu lato. *Taxon* **50**: 203-241.

TOM W. MAY

Royal Botanic Gardens Melbourne, Private Bag 2000,
South Yarra 3141, Australia

I Funghi: I funghi del Giardino Inglese della Reggia di Caserta. By Nicola Terracciano. March 2006. Nuova Micologia, Associazione di studi Micologici Onlus, Via di Villa Patrizi 2/c, I-00161 Rome, Italy (e-mail: c/o rambelli@unitus.it). Pp. 199, numerous annotated line drawings. ISBN not indicated. Price: 25 €.

Nicola Terracciano (1837-1921) was Director of the Real Giardino e orto Botanico di Caserta from 1862-1903, and the garden is viewed as if a nature reserve in the midst of a city conurbation. She published extensively on plants, and was not an expert mycologist, but made careful drawings and extensive macroscopical observations on 137 macromycetes she encountered, including vertical sections. The original drawings and notes are published here for the first time, along with commentaries as to their probable identities by mycologists in Nuova Micologia; the Italian commentaries are followed by translations in English. Almost all are agarics, and while not all the species could be reliably identified, most could and so this provides a valuable record of the macromycetes present in the garden during that period. It would be interesting to compare these records with species present today. This is a delightful historical work to dip into while relaxing with a Campari and soda, and I am sure it will be enjoyed by many mycologists fortunate enough to obtain a copy. The publication was made possible through the Ministero per i Beni e le Attività Culturali of Italy, and it is pleasing to see the importance the Ministero clearly attaches to fungi as a part of Italy's culture.

Fungi of Australia: *Hygrophoraceae*. By Anthony M. Young. 2005. CSIRO Publishing, PO Box 1139 (150 Oxford St), Collingwood, VIC 3066, Australia (e-mail: publishing.sales@csiro.au; orders@edspubs.co.uk for Europe). Pp. 188, 51 illustrations, colour photos 60, maps 92. ISBN 0 643091955. Price: AU\$ 135.

This is a regional monographic treatment of the *Hygrophoraceae* of Australia that is well illustrated with colour photographs and line drawings. It includes 92 species and infrageneric taxa of *Hygrophorus*, *Hygrocybe* s. lat., *Camarophyllopsis*, and *Humidicutis*,

including photographs of several undescribed taxa. The introduction is very informative, especially with regard to a recently updated history of systematics and nomenclature in the *Hygrophoraceae* and references to recent molecular phylogenies. Recent findings, such as the pinkish or violaceous spore deposits of *Hygrocybe lilaceolamellata* and *H. erythrocrenata*, are found in the introduction rather than the discussion of those species in the main text. The history of research on *Hygrophoraceae* in Australia is also covered in the introduction, elegantly tracing a complex history of misapplied names in Australia. Most of the descriptions, line drawings, and systematic treatments have been published previously with the exception of one new species, *Hygrocybe schistophila*, and the recombination of eight *Hygrocybe* species into *Humidicutis*. Segregate genera other than *Humidicutis* were retained at the subgeneric rank in *Hygrocybe*. Differences in scale between illustrations of species in composite figures and among figures make comparisons more challenging, but the quality and detail of the line drawings are excellent. A few taxonomic placements have not been updated, such as the concept of *H. miniata* that is not consistent with the neotype of Boertmann. Other than the excellent discussion of introduced species, there is little discussion of similarities and possible relationships with species in other parts of the world, but considering the history of presumed relationships of Australian basidiomycete species with others from elsewhere which have since proved incorrect, this may be a safer approach. However, it is the addition of 60 stunning color photographs of these taxa that make this book so appealing and valuable to those who are studying *Hygrophoraceae* or are interested in fungi of Australasia. In particular, the photograph of *Hygrocybe anomala* leaves no doubt that is correctly placed despite the presence of a mixture of spiny and smooth basidiospores. Young's description of the spiny spores as "often polygonal outline with spines emerging from the angles of the polygons" makes one wonder if there is an ancestor with this character. Such details, together with the most recent synopsis of systematics in the *Hygrophoraceae* that are included in this book, should broaden its appeal to include mycologists who are working to reconstruct the phylogeny of the *Agaricales* in the Assembling the Fungal Tree of Life (AFTOL) program.

D. JEAN LODGE

*International Institute of Tropical Forestry, USDA-Forest Service,
PO Box 1377, Luquillo, PR 00773-1377, USA*

Flora Agaricina Neerlandica: Critical monographs on families of agarics and boleti occurring in the Netherlands. Edited by M.E. Noordeloos, T.W. Kuyper and E.C. Vellinga. Volume 6. 2005. Taylor & Francis Group, PO Box 409267, Atlanta, GA 30384-9267, USA. Pp, 227, figs 215. ISBN 10: 9 05 410496 1; 13: 978 9 05 410496 4. Price: US\$ 59.95, £ 36.99.

This ambitious attempt to monograph all of the Netherlands agaric and bolete genera takes a significant step forward with volume 6, providing much needed up-to-date coverage of *Coprinus sensu lato*, *Bolbitius*, *Conocybe*, *Pholiotina* and *Agrocybe*. Following the format of earlier volumes, the taxonomic chapters provide clear and comprehensive keys, with detailed macro- and microscopic descriptions for each taxon, references to published descriptions, selective synonymy and details of habitat

and distribution. There are no photographs or coloured drawings but each species is accompanied by excellent line drawings of fruit bodies and critical microscopic features with references to published icons. Although the flora specifically aims to cover all the species found in the Netherlands, extralimital species are included in the keys, although not necessarily in the index, and the coverage is valuable and applicable throughout Europe and beyond.

The chapter on *Coprinus* is particularly welcome. Following the sudden and very sad death of its author, C. (Kees) B. Uljé in 2003, the editors have been able to complete a manuscript that was at an early stage of editing at that time. The chapter adds new coverage of subsections *Atramentarii*, *Coprinus*, *Domestici*, *Micacei* and *Narcotici* to the coverage of subsections *Alachuani*, *Auricomi*, *Glabri*, *Lanatuli*, *Nivei* and *Setulosi* published earlier in preparation for the flora but now updated and with descriptions of recently published species.

Kees Uljé's extensive studies of *Coprinus s. lat.* have provided the major recent foundation for the study of these species throughout Europe and this compilation will now be the first point of reference for all mycologists studying these species. All but four of the *Coprinus s. lat.* taxa listed in the 2005 British basidiomycete checklist are covered. In subsections *Domestici* and *Micacei*, all of the current contenders as possible species are described or keyed out, including *C. ellisii*, *C. saccharinus* and *C. pallidissimus*. This is usefully comprehensive but I suspect that the author had not completed his studies of these taxa. In subsection *Narcotici*, *C. sclerotiger* is synonymised with *C. tuberosus* and the status of *C. radicans* as an independent species is considered unclear. Earlier synonymies are discussed in the (fully referenced) publications and less so in the flora.

Recent molecular studies of the phylogeny of coprinoid fungi are discussed in the introduction to the *Coprinus* chapter. The editors accept that the *Coprinus comatus* group must be transferred to the *Agaricaceae* but, surprisingly, not the consequential need to change the names of the remaining coprinoid fungi, despite the failure of the proposal to change the type of *Coprinus* from *Coprinus comatus*. The flora recognises *Coprinaceae*, including *Panaeolus s. lat.* (not treated) and *Psathyrella/Lacrymaria* (not treated), whilst acknowledging that this is questionable in light of the molecular phylogeny studies. None of this detracts from the value of the chapter as a guide to the identification of coprinoid species and synonymy is provided to published *Coprinopsis*, *Coprinellus* and *Parasola* names, with a useful summary relating these genera to the eleven subsections.

The rest of the book treats the *Bolbitiaceae*, acknowledged as polyphyletic and not a natural entity based on current molecular phylogeny, but retained for the flora pending further studies. The genera treated are *Agrocybe*, *Bolbitius*, *Conocybe* and *Pholiotina*, the separation of the latter from the rest of *Conocybe* being supported by molecular studies.

The *Bolbitius* chapter by Eef Arnolds provides a much-needed recent treatment and recognises eight taxa (including the five in the 2005 British and Irish checklist). I personally would prefer less use of entities below species level (variety and form, some of which are treated in the descriptions and not in the key), in favour of more species, but there is detailed discussion of the relationships with other taxa and references to published literature, so the taxonomic distinctions are clearly made.

The two chapters on *Conocybe* and *Pholiotina* respectively, both by Eef Arnolds, provide clear and workable keys to a difficult group of fungi. The coverage, including detailed discussion of relationships with other taxa, ecological preferences and reference to other published studies, is particularly helpful. Work elsewhere in Europe, by Hausknecht, Watling and others is referenced in detail. In such a difficult genus, examination of critical specimens would no doubt best include a look at some of the original literature as well as the flora. However, I judge this an excellent, detailed and comprehensive study and the essential starting point when studying species in these genera.

Last, but not least, the chapter by Marijke Nauta is an excellent treatment of *Agrocybe*. An alternative key is a useful addition and one that others might emulate given the inevitable practical difficulties of the dichotomous key. Seventeen taxa are described or keyed out, including two new species for the Netherlands found in the course of the work for the flora. The *Agrocybe* species included in the British checklist are all there, give or take some synonymy and a number of different names.

There is an extensive and precise glossary in each volume of the flora that I find very useful, despite occasional omissions (e.g. *setulae*) or errors (e.g. *papillate*, which seems to have survived since volume 1). I found a few minor errors in the *Coprinus* keys (steps 31 are transposed; *C. singularis* is species 38; species 37 is *C. pseudoamphithallus*; species 83 in the key should be *C. phlyctidosporus* as in the text not *C. lagopides* which is incorrect (as it is also in the British and Irish checklist). Also, in the *Coprinus* main section, Figures 41 and 42. are transposed, in figure 35 "PL" should read "CH", and figure 37 should be labelled *C. pseudoamphithallus*.

In summary, despite some typographical errors that need to be noted by the user, this is an excellent volume and an essential guide and manual for any mycologist studying these genera. These are all difficult genera and the task of identifying the taxa is well served by the meticulous, detailed and comprehensive approach of the series demonstrated in this latest volume.

DEREK SCHAFER

8 Hawleys Lane, Whitchurch, Bucks HP22 4LB, UK

The Genus *Hebeloma*. By Jan Vesterholt. 2005. Danish Mycological Society, Svampetryk, Kornblomstvej 6, DK-8381 Tbst, Denmark (e-mail: svampetryk@webspeed.dk). Pp. 146, ISBN 87-983581-6-2. [Fungi of Northern Europe Vol. 3.] Price: DKR 198.

Fortunately, and despite the current situation of decline in general taxonomic expertise, books like "*The Genus Hebeloma*" are still being published. If the inventory and conservation of the daunting number of existing fungi have to become real scientific goals, then we must seriously promote taxonomic work. In this regard, *Hebeloma* is a taxon in need of much more research. Unfortunately, as says Vesterholt, "*Hebeloma* species are often neglected, mainly because the lack of critical literature makes them very difficult to identify. It does not count in their favour either that none are considered edible (...)". Nevertheless, despite the lack of this edible use value, *Hebeloma* species play

a central role as pioneer mycorrhiza formers in those ecosystems in which they live. Therefore we need comprehensive monographs in order to be able to identify these species and manage adequately these ecosystems.

Jan Vesterholt has published a well-illustrated monograph dealing with the north European species of *Hebeloma*, which is the result of 24 years of extensive research. Many of the species studied are also present in the European Mediterranean region, so this book will certainly be useful too for the mycologists of these areas.

The book commences with a general introduction in which the taxonomical status of the genus is discussed. Then a chapter follows in which all macro- and micromorphological characters of the genus, useful from a taxonomical point of view, are revised. However, though this monograph is based on a morphological taxonomical concept, Vesterholt has integrated, whenever possible, available molecular data. So, for instance, he has synonymized (p. 39) *Hebeloma mesophaeum* var. *lacteum* and var. *crassipes* with *H. sordidum* on the basis of molecular evidence. This is a good example of how we should proceed in future: to combine morphological and molecular data to gain accuracy in our taxonomy.

Vesterholt also contributes with a new infrageneric classification, different from the traditional concepts of other authors like Bruchet, Moser, and Bon. Although it is currently very difficult to establish a phylogenetic infrageneric classification (cfr Aanen et al. 2000; Thomas et al. 2002), Vesterholt has made an effort to put together a more natural classification by analyzing the origin of the veil present in the different species. This has resulted in an infrageneric scheme different from the preceding ones "... to a large extent based on the presence or absence of a veil (of any origin) ...". Undoubtedly it is important to distinguish between the different origins of the veil. The introductory part ends with a key to species, easy to follow and based on clear characters, which helps greatly in identifying them.

The core of the book consists of 97 pages in which 45 species growing in the geographic area studied by Vesterholt are fully described. However, according to the author the molecular data show that there are more species (not recognizable by morphological characters) in the geographic area covered than are included in the book. Descriptions of individual species include: name, synonym(s), detailed macro- and microscopic description, ecology and distribution, a taxonomic discussion, line drawings of useful microscopic characters, and one or more colour photographs. The excellent illustrations certainly facilitate the identification of species, especially the nice colour photographs. Surprisingly some of the photographs, e.g. *H. bruchetii*, appear out of focus!

Nomenclature has completely been revised and updated, so if someone wants to look for such a well-known species as *H. edurum* he or she will have to look under *H. laterinum*, which is its correct name! The taxonomic treatment is, altogether, clear and adds to the understanding and identification of the species of this genus. The long experience of the author based on both extensive field work and the study of numerous type specimens has resulted in some synonymies such as: *H. subcaespitosum*, *H. psammicola* and *H. aprile* as synonyms of *H. collariatum*; or *H. calyptosporum*, *H. danicum*, *H. anthracophilum*, *H. nitidum*, *H. politum*, *H. herrmanniae* and *H. pumilum* all as synonyms of *H. birrus*. However, this broad concept does not refrain him from describing formally a good new species, *H. vejlsense* (p. 98).

The book ends with a complete reference list in which one can find all the essential papers dealing with *Hebeloma*; very useful for all who want to start studying this genus.

In summary, Vesterholt's book is a milestone in the taxonomy of *Hebeloma*, and should not be absent from the library shelves of any mycologists, especially those interested in *Agaricales*. It is absolutely a must!

MICHEL HEYKOOP FUNG-A-YOU

Calle Ávila 20, Meco, Madrid 28880, Spain

Ascomycetes

An Illustrated Guide to the Coprophilous Ascomycetes of Australia. By Ann Bell. 2005. Centraalbureau voor Schimmelcultures, P. O. Box 85167, 3508 AD Utrecht, The Netherlands (e-mail: info@cbs.knaw.nl). Pp. x + 172, figs 115. ISBN 90 70351 580. [CBS Biodiversity Series No. 3.] Price: 55 €.

This work is very much a tribute to "Major" Harry Dade (1895-1978), who was in charge of and pivotal in developing methods for the preservation and examination of the living collections at the then Imperial (later Commonwealth and International) Mycological Institute at Kew from 1935-1962. After he retired to Australia, as a person especially skilled in microscopy he took a particular interest in dung ascomycetes and occasionally sent exquisite slides for me to examine when I was employed at Kew. I can therefore relate very much to this volume which has the fullest account of his career from service in World War I to Government Mycologist in Ghana to his passion for bee-keeping (there also were reputed to have been hives kept on Institute grounds not mentioned here) and his role in the Queckett Microscopical Society. Ann Bell has had access to Dade's research notes on some 900 dung collections, and many of his slides, and she has used these to build with subsequent work into this major and finely illustrated work on dung ascomycetes in Australia.

The species are arranged by class, order, family and genus, and then with keys to the Australian coprophilous species. Sadly there is no key to the higher taxa, but the illustrations largely speak for themselves. What is most important is that the species are well illustrated by numerous line drawings, many in colour and taken from Dade's notes and sketches. Graphs showing variations in spore dimensions are also included for some species. In addition, as might be expected for Australia, ten species are described as new to science in the genera *Ascobolus*, *Cercophora*, *Fimetariella*, *Mycoarcticum*, *Podospora*, *Sporormiella*, and *Strattonia*.

While not as globally comprehensive as Doveri's work⁴ (2004), which covers all groups of coprophilous fungi and not only ascomycetes (and which surprisingly is not cited), this is a superb publication at a most modest price that no workers on dung fungi should be without.

And if you ever thought dung fungi were boring, see Dade's coloured "Dungscape" painting that takes pride of place as Plate 1 in this book.

Doveri, F. (2004) *Fungi Fimicoli Italici*. Associazione Micologica Bresadola, Trento.

⁴Reviewed in *Mycotaxon* 90: 220-221 (2004).

Les Oïdiums de Suisse (Erysiphacées). By Adrien Boly. 2005. Editions Rossolis, Rue Montolieu 5, CH-1030 Bussigny, Switzerland (e-mail: rossolis@rossolis.ch). Pp. 176, figs 128. ISSN 0257 9421. [Cryptogamica Helvetica No. 20.] Price: CHF 60.

This is a comprehensive account of the powdery mildews recorded in Switzerland up to 2004. Useful introductory sections contain details of the anatomy of erysiphalean anamorphs and teleomorphs and a discussion of the systematics of the family *Erysiphaceae*, including recent changes in generic dispositions based on molecular evidence. Methodology and a specific glossary are also included. Keys are provided to identify via morphology of the pathogen and/or identity of the host plants. The Swiss members of ten genera are then described and discussed, viz: *Arthrocladiella*, *Blumeria*, *Erysiphe* (including *Microsphaera* and *Uncinula*), *Golovinomyces* (syn. *Erysiphe* sect. *Golovinomyces*), *Leveillula*, *Neoerysiphe* (*Erysiphe* p. p.), *Oidium* (for unlinked anamorphs), *Phyllactinia*, *Podosphaera* (incl. *Sphaerotheca*) and *Sawadaea*. There is also a section on undescribed anamorphs that have occurred in Switzerland. The descriptions are accompanied by clear line drawings and the whole work is fully indexed.

The publishers are to be congratulated on the high standard of production and the series in general deserves to do well. The current volume is one that I would have been most glad to have had when I started my own researches into Swiss powdery mildews 15 years ago. The attention to detail and the care taken in preparing this work is typically Swiss. There are only two minor criticisms: (1) there is relatively little detail about the distribution of most species in Switzerland; and (2) there is rather sparse discussion about the spread of several species from Asia and North America into Europe, and particularly Switzerland, in the last decade — surely one of the more interesting areas for bioclimatic research. The latest arrivals did not reach Switzerland in time for inclusion, for instance *Erysiphe ellisii* on *Carpinus* was not identified in Switzerland until 2005. These points in no way reduce the value and interest of this excellent work which should be in the libraries of all workers on the group and all Swiss plant pathologists.

BRUCE ING

Clwyd Mycological Institute, 24 Avon Court, Mold, Flintshire CH7 1JP, UK

A World Monograph of the Genus *Plectocarpon* (Roccellaceae, Arthoniales). By Damien Ertz, Claude Christnach, Mats Wedin & Paul Diederich. 2005. J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, Johannesstrasse 3A, D-70176 Stuttgart, Germany (e-mail: mail@schweizerbart.de). Pp. 155, figs 123. ISBN 3 443 58070 X. [Bibliotheca Lichenologica No. 91.] Price: 58 €.

It has been evident since the study of Diederich & Etayo (1994) that the lichenicolous genus *Plectocarpon* was more speciose than the 1-2 species traditionally assumed when the generic name was resurrected (Hawksworth & Galloway 1984). This monograph makes the point as a result of extensive collections made in recent years: 32 species are accepted here of which 15 are new to science and two are newly combined into the genus. Most species occur on members of *Peltigerales*, especially Southern Hemisphere species of *Lobaria* (6 species), *Nephroma* (3), *Pseudocyphellaria* (11+), and *Sticta* (3). The species are all described in detail with full discussions of the nomenclature and

well illustrated by halftones (many of which have not reproduced as well as I would have hoped) and line drawings of asci and ascospores. All seem to be well separated microscopically and this is clearly a pivotal work in studies of these fungi. I have used the key to identify some material hiding in my drawers for too many years successfully.

The placements and typifications of various other taxa examined during the study are discussed in detail and, as a result, several are either described in or combined into the genera *Arthonia*, *Enterographa*, *Opegrapha*, *Perigrapha*, and *Sigridea*.

I was especially pleased by the discussions of host-specificity and biogeography (which include world distribution maps for several species) and intrigued by the suggestion that the host lichens *Pseudocyphellaria anomala* and *P. anthraspis* might be better placed in *Lobaria* as recent molecular studies have indicated they are not monophyletic with *Pseudocyphellaria s. str.*

This is a most carefully executed monograph, on which the authors are to be congratulated, and will be required by all workers on lichenicolous fungi.

Diederich, P. & Etayo, J. (1994) Taxonomic notes on the genus *Plectocarpon* (lichenicolous *Ascomycotina*). *Nordic Journal of Botany* 14: 589-600.

Hawksworth, D. L. & Galloway, D. J. (1984) The identity of *Plectocarpon* Fée, and its implications for *Lichenomyces psuedocyphellaria* and the typification of *Sticta delisea*. *Lichenologist* 16: 85-89.

Lichen-forming fungi

Norsk Lavflora. By Håkon Holien & Tor Tønsberg. 2006. Tapir Akademisk Forlag, Nardovegen 14, NO-75005 Trondheim, Norway (e-mail: forlag@tapir.no). Pp. 224, numerous coloured plates. ISBN 82 519 1978 9, 13: 978 82 519 1978 4. Price: NKR 395.

If you thought that the pinnacles of what might be achieved in lichen photography had already been reached by Brodo *et al.* (2001)⁵ and Wirth (1995) this new book will necessitate a re-think. After a well-illustrated account of lichen characters, introductions to their uses, ecology, and methods of collection and examination, superb full-colour photographs of 330 species are presented, including 194 macrolichens and 134 crustose species. To grant so much coverage to crustose species is especially welcome as there has been a long tradition in Norway of lichen guides focussing only on macrolichens. Each species generally has half a page (a few merit a whole one) comprising a photograph (in some cases with insets), the scientific and Norwegian common name and five lines of text on the characters, ecology and distribution. There is no key, and the pictures are allowed to speak for themselves. The quality of the colour reproduction is really top-notch, though as always there are problems catching the special yellow-green hues of pulvinic acid derivative-containing taxa such as *Letharia vulpina* and *Rhizocarpon geographicum*. There is a list of selected references, a glossary, a list of the meaning of names, and separate indices to Norwegian and scientific names. One aspect that I am sure will frustrate users, however, is that while the species are treated in two main growth-form groups, within those they are arranged by order and family. This means: (1) that you have to go to the index to find where a species is treated if you not aware

⁵Reviewed in *Mycotaxon* 82: 481-482 (2002).

of its systematic placement; and (2) that genera belonging to the same order of family are separated into the different sections. An arrangement by thallus types, with genera treated alphabetically within them, would have been so much simpler, perhaps with a table to show the hierarchical classification.

The authors are leading specialists in the taxonomy of macro- and microlichens in Norway, respectively, and the nomenclature is generally up-to-the-minute, though it should be *Parmotrema perlatum*, not “*perlata*”, and the changes in the concepts of *Melanelia* and *Xanthoparmelia* probably came too recently to effect changes.

As many of the species illustrated so finely have wide distributions in the Northern Hemisphere, I am sure all lichenologists in Europe and North America who saw a copy would want to have this in their libraries.

Brodo, I. M., Sharnoff, S. V. & Sharnoff, S. (2001) *Lichens of North America*. Yale University Press, New Haven.

Wirth, V. (1995) *Die Flechten Baden-Württembergs*. 2 vols. Eugen Ulmer, Stuttgart.

Lichen Flora of the Greater Sonoran Desert Region. Vol. 2 (most of the microlichens, balance of the macrolichens, and the lichenicolous fungi).

Edited by Thomas H. Nash III, Bruce D. Ryan, Paul Diederich, Corinna Gries & Frank Bungartz. June 2004. Lichens Unlimited, School of Life Sciences, Arizona State University, Box 874501, Tempe, AZ 85287-4501, USA (e-mail: tom.nash@asu.edu). Pp. x + 742, maps, photographs, colour plates. ISBN 0 9716759 1 0. Price: US\$ 39.95.

This is the second volume of this major work⁶, though “flora” is a misnomer since lichens are not plants! The first volume dealt with some of the macrolichens, squamulose species, pyrenocarpous lichens, the generic accounts being by a host of international authorities as is the case in this second volume.

Following the same format as the first volume, the second covers a wide range of lichens, but also includes a separate section on lichenicolous fungi. It starts with a section of generic keys, followed by alphabetically arranged genera and species, including keys to the latter. Over 100 genera and about 700 species of lichens, together with 53 genera and 100 species of lichenicolous fungi, are treated. Under each are details of morphology, anatomy, sexual strategies and chemistry, together with notes on ecology and distribution. Maps of distribution in the Sonoran Desert Region are also included for selected species, together with some half-tone photographs – some better than others. However, there is a section of 96 colour photographs covering 94 species, which are excellent but not numbered. A listing of lichenicolous fungi under the host lichen species would have proved useful.

A total of 85 taxa are either described as new to science or introduced as new combinations, including lichens and lichenicolous taxa. The taxonomy is mostly up to date, though many narrow generic concepts are maintained (e.g. *Xanthomendoza*, *Niebla*, *Neofuscelia*).

⁶Vol. 1 is reviewed in *Mycotaxon* 86: 485–486 (2003).

This is a really excellent second volume and I eagerly await the publication of the third which is promised to cover over 25 additional lichen genera and two further genera of lichenicolous fungi.

PETER M. EARLAND-BENNETT

44 Sherwood Way, Southend-on-Sea, Essex SS2 4SR, UK

Contributions to Lichen Taxonomy and Biogeography Dedicated to Leif Tibell. Edited by Göran Thor, Anders Nordin & Inga Hedberg. 2004. Department of Systematic Botany, Evolutionary Centre, Uppsala University, Uppsala, Sweden [order from Uppsala Universitetsbibliotek, Box 501, Dag Hammarskjöld väg, S-751 20 Uppsala, Sweden (e-mail: acta@ub.uu.se).] Pp. 499. ISBN 91 554 6025 9. [Symbolae Botanicae Upsalienses No. 34(1).] Price: SKR

This volume of collected papers celebrates the 60th birthday of Leif Tibell, a distinguished mycologist who has devoted most of his career to the elucidation of the systematics of calicioid fungi, whether lichenized or not, making extensive use of electron microscopes and also cultural approaches, and always at the forefront in adopting new methods in systematics. There are 32 contributions from friends and colleagues from around the world, and papers deal with lichens, lichenicolous fungi or photobionts from areas as diverse as Ecuador, Mexico, New Zealand, North America, Siberia, southern Africa, Taiwan, and Tasmania – as well as Europe, and especially Scandinavia. All lichenologists are sure to find something of interest to them here, but it would be somewhat invidious to single out particular papers here.

Lichen-forming, Lichenicolous and Allied Fungi of Israel. By M. Temina, S. Y. Kondratyuk, E. Nevo & S. P. Wasser. 2005. A. R. G. Ganter Verlag Kommandit Gesellschaft, FI 9491 Ruggell [order from: Koeltz Scientific Books, Herrnwaldstrasse 6, D-61462 Königstein, Germany (e-mail: koeltz@t-online.de)]. Pp. 384, coloured plates 25, maps. ISBN 3 906166 41 4, 978 3 906166 41 4. [Biodiversity of Cyanoprokaryotes, Algae and Fungi of Israel No. 6.] Price: € 72.

Knowledge of the lichens of Israel has developed rapidly in recent years, and this book covers 112 genera and 335 species, almost twice the number in the classic work of Galun (1970). The volume starts with an overview of the natural features of Israel, a history of lichenological investigations in the country, including ecological and experimental investigations. Following a key to the genera, these are then treated alphabetically, each species account including sections on description, habitat, distribution in Israel, general distribution, and references. In some cases distribution maps are provided, though many have only a single “dot” and make it clear that more field work is needed, and not only in the “Palestinian territories . . . not available for our access” (p. 8). There are no line drawings, but 25 colour plates covering 150 species are bound together at the end of the book, although sadly the quality of their reproduction is far from what can be achieved by modern digital methods and the distorted colours of some might preclude correct identifications. I suspect many of the photographs were prepared from preserved specimens and not taken from fresh material in the field.

While the coverage of the Israeli literature is good, that of recent general systematic lichen literature is poor, with hardly any papers appearing after 2000 being cited apart from ones from the authors' research groups. This means that the whole has a somewhat dated appearance, with one notable exception: the treatment of *Xanthoria* of which Kondratyuk is a specialist. Ten species are accepted in that genus, and to have a key to these in English rather than Russian or Ukrainian is most welcome, though I was surprised to see the name *X. papillifera* used for *X. ectaneoides* since *X. aurolea* appears to be the correct name for that species.

There are numerous small and sometimes irritating mistakes, and it is clear the book would have benefited from the editorial pen of an experienced lichenologist. Nevertheless, this is a great step forward in providing a framework for future studies of Israeli lichens and means that ecologists as well as lichenologists in the country will be able to identify a much greater proportion of their collections than was hitherto possible.

Galun, M. (1970) *The Lichens of Israel*. Israel Academy of Sciences and Humanities, Jerusalem.

Hongos Liquenizados. By Martha Chaparro de Valencia & Jaime Aguirre Ceballos. November 2002. Universidad Nacional de Colombia, A. A. 7494, Bogotá DC, Colombia. Pp. 220, figs 63, incl. 8 coloured plates. ISBN 958 701 241 0. Price: Not indicated.

The lack of textbooks and identification guides in Spanish and Portuguese to lichens in South America is a major constraint to their study in the continent. It is therefore very pleasing to welcome this textbook. It covers the nature of lichens, the partners, anatomy and morphology, establishment and growth, ecology, chemotaxonomy, classification, methods of collection and study, a glossary, and a balanced bibliography with references including ones from 2000. The section on classification is in two main parts. First, there is a 23-page key to macrolichen genera in the Andes and Páramo, which includes many of the recently segregated genera. Second, there is a systematic arrangement by orders and families, with notes on their characters, which includes genera of all growth forms recorded in the country. Further, the number of species known from Colombia is placed after each generic name. Although the system used is somewhat dated (being based on the 1998 "Outline of the Ascomycetes") this is sure to be a great help to those starting to struggle with Colombian lichens. Sadly, the paper quality and level of resolution used in printing do not do justice to the coloured photographs, though the species are, in general, recognizable. As there is such a shortage of general lichen textbooks in Spanish, this work merits a wide circulation in Spain as well as in Central and South America.

Conidial fungi

Sporidesmium, *Endophragmiella* and Related Genera from China. By Wenping Wu and Wenying Zhuang. January 2005. Fungal Diversity Press, Centre for Research in Fungal Diversity, Department of Ecology and Biodiversity, University of Hong Kong, Pokfulam Road, Hong Kong SAR, People's Republic of China. Pp. x + 351, figs 152, tables 1. ISBN 9628 6765 8 X. [Fungal Diversity Research Series No. 15.] Price: US\$ 60.⁷

This book reports 143 species in 25 genera of dematiaceous hyphomycetes in the *Sporidesmium* and *Endophragmiella* complex from mainland China. Among these fungi are one new genus, 43 new species, and 16 new combinations. In this complex, the conidiophores are macronematous, mononematous sometimes synnematos, with or without percurrent proliferations or reduced to a single conidiogenous cell. These cells are integrated, terminal, and with or without percurrent proliferations. The conidia are euseptate or distoseptate and vary in shape from obclavate, fusiform, rostrate, ellipsoidal, obovate, clavate or cylindrical and usually have a truncate base and an acute or rounded apex. Conidial secession is schizolytic or rhexolytic.

In the introductory pages, a short discussion is given of the included genera. This consists of a brief history along with the mode of conidiogenesis and the morphological characters used to describe the conidiophores, conidiogenous cells, and conidia. A table is presented for the known teleomorph-anamorph connections. Among the genera synonymised in this treatment are *Podoconis*, *Penzigomyces*, *Imimyces* and *Imicles*. A dichotomous key is presented for the genera found in China based on conidial shape and septation, conidiophore characters and the nature of the conidiogenous cell.

Sporidesmium s. str. of Subramanian is represented in this work by 13 new species and 19 new records. Each of these species is comprehensively described and beautifully illustrated. A dichotomous key to 36 species is given based on the characters of the conidiogenous cells, conidiophores and conidia. In this treatment of *Sporidesmium*, the following points were noted: on p. 12 couplet 6, *S. "mucurum"* should be *S. macurum*; *S. flagellatum* mentioned on pages 14 and 75 is omitted from the index; on p. 38, fig. 16, the epithet should be "*guadongense*" not "*guangdongse*"; in the notes for *S. nivae* on p. 53, the ? species *S. domingshanse*, not treated in this work, is compared with *S. njalaense*; in the treatment of *Stanjehughesia*, a segregate genus of *Sporidesmium*, four of the seven species are novelties; on p. 89 line 4, the sentence should read '1 locus per conidiogenous cell'; *Ellisembia* as circumscribed here includes the genus *Imicles*; in all 27 species are described and illustrated, including six novelties and 11 new combinations; in the key on p. 105, couplet 8 should read *E. calyptrate*, and on p. 106 couplet 24 *E. plovercovensis*; and *Ellisembia crassisporea* described on p. 125 is omitted from the index. *Linkosia multiseptatum*, described on p. 185 is omitted from the index along with *Morrisiella indica* (the type species of *Morrisiella*, described and illustrated on p. 190).

The new genus, *Novozymia*, typified by *N. elegans*, is described from Guangdong Province. The conidiophores are synnematos, the conidiogenous cells annelidic, and

⁷See also the more general review in *Mycotaxon* 94: 389-390 (2006 ["2005"]).

the conidia are distoseptate and secede by schizolytic succession. *Sporidesmina* is represented in China by the type species, *S. malabarica* and is considered to have similar conidiogenesis to *Sporidesmium* but differs in being synematus and the conidia have a mixture of eu- and distosepta. Five species of *Brachysporella* are treated, of which one is new and one a new combination. In the key on p. 208, couplet 2 prime should read 2-septate. The sanctioning author for *Actinocladium*, listed in the table of contents on p. v should be Fries. *Ceratosporella disticha* and *C. flagellifera* should be listed in the index as on p. 239. The authorities for *Tripasporium foliicola* in the legend of fig. 109 on page 243 should be "Gamundí, Aramaní & Giaioti".

Endophragmiella and related genera form the second large group of hyphomycetes treated by Wu & Zhuang. A key to eight genera is presented based on the presence or absence of appendages on the conidia, conidial septation, branched or unbranched conidiophores, the width of the conidiogenous locus and the presence or absence of a basal, downward directed fimbriate margin on the conidia. Conidial succession is rhexolytic.

Many of the hyphomycetes reported here have previously been noted elsewhere, and the excellent keys, complete descriptions, and the well executed illustrations make this work a valuable identification manual for areas both within and outside of China. Contrary to Rec. 7A of the *Code*, the type material of the novelties described in this work remain in the first author's personal herbarium. Also, 29 of the 152 figures in the manual have inverted numerals on the scale bar, and while the place of original publication is given for each new combination, the word basionym is not employed.

It is also interesting to note that the descriptions and illustrations presented here are based solely on Wenping Wu's collections. With a little more proof-reading and editing, this treatment could have met the high standards set by Martin B. Ellis and "Stan" J. Hughes.

Ellis, M.B. (1971) *Dematiaceous Hyphomycetes*. Commonwealth Mycological Institute. Kew.

Ellis, M.B. (1976) *More Dematiaceous Hyphomycetes*. Commonwealth Mycological Institute. Kew.

Hughes, S. J. (1979) Relocation of species of *Endophragmia* auct. With notes on relevant generic names. *New Zealand Journal of Botany* 17: 139-188.

J. LELAND CRANE

*Illinois Natural History Survey, 1816 South Oak St,
Champaign, IL 61820, USA*

Nomenclatural novelties proposed in Mycotaxon 96

- Achroomyces dennisii* P. Roberts, p. 100
- Agyrium aurantium* W.Y. Zhuang & Zhu L. Yang, p. 169
- Antrodiella ellipsospora* (Pilát) Niemelä & Miettinen, p. 219
- Antrodiella leucoxantha* (Bres.) Miettinen & Niemelä, p. 224
- Antrodiella pachycheiles* (Ellis & Everh.) Miettinen & Niemelä, p. 226
- Antrodiella pallescens* (Pilát) Niemelä & Miettinen, p. 227
- Antrodiella serpula* (P. Karst.) Spirin & Niemelä, p. 231
- Antrodiella subradula* (Pilát) Niemelä & Miettinen, p. 233
- Beltraniopsis aquatica* R.F. Castañeda & M. Stadler, p. 155
- Brevicatenospora* R.F. Castañeda, Minter & Saikawa, p. 152
- Brevicatenospora enteroproliferata* R.F. Castañeda, Minter & Saikawa, p. 153
- Cephalotheca foveolata* Yaguchi, Nishim. & Udagawa, p. 314
- Chlorophyllum sphaerosporum* Z.W. Ge & Zhu L. Yang, p. 187
- Cystoderma andinum* I. Saar & Laessøe, p. 124
- Cystoderma papallactae* I. Saar & Laessøe, p. 126
- Didymium reticulosporum* Novozh. & Zeml., p. 148
- Exidia aeruginosa* P. Roberts, p. 91
- Exidiopsis scutelliformis* (Berk. & M.A. Curtis) P. Roberts, p. 94
- Exobasidium racemosum* Z.Y. Li & L. Guo, p. 324
- Graphis albidofarinacea* Adaw. & Makhija, p. 53
- Graphis cinnamomea* Adaw. & Makhija, p. 54
- Graphis colliculoides* Adaw. & Makhija, p. 54
- Graphis kollaimalaiensis* Adaw. & Makhija, p. 55
- Graphis nigrocarpa* Adaw. & Makhija, p. 56
- Graphis nilgiriensis* Adaw. & Makhija, p. 59
- Graphis verruciformis* Adaw. & Makhija, p. 58
- Inocutis texana* (Murrill) Seb. Martínez, p. 3.
- Kananascus europaeus* Treigienė, p. 174
- Koorchaloma europaea* Treigienė, p. 177
- Lactarius aurantiosordidus* Nuytinck & S.L. Mill., p. 302
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p.20, line 28	for: <i>P. puiggarii</i>	read: <i>Polystictus puiggarii</i>
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p.73, line 39	for: <i>tomini</i>	read: <i>tominii</i>
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Pacific Northwest Mycology Service
6720 NW Skyline Boulevard
Portland, OR 97229, U.S.A

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Manaaki Whenua Landcare Research
Auckland, New Zealand

David L. Hawksworth
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Colonia La Maliciosa, Mataelpino
ES-28411 Madrid, Spain

Karen D. Gettelman
INDEX EDITOR
510 Lake Blvd., Apt. 166
Davis, CA 95616
U.S.A.

Grégoire L. Hennebert
FRENCH LANGUAGE EDITOR
32 Rue de l'Élevage
B-1340 Ottignies - LLN
Belgium

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EDITOR-IN-CHIEF**LORELEI L. NORVELL**

editor@mycotaxon.com

Pacific Northwest Mycology Service

6720 NW Skyline Boulevard

Portland, Oregon 97229-1309 USA

ASSOCIATE EDITORS**NOMENCLATURE EDITOR****SHAUN R. PENNYCOOK**

PennycookS@LandcareResearch.co.nz

Manaaki Whenua Landcare Research

Auckland, New Zealand

BOOK REVIEW EDITOR**DAVID L. HAWKSWORTH**

MycNova, Calle Aguila 12

Colonia La Maliciosa, Mataelpino

ES-28411 Madrid, Spain

FRENCH LANGUAGE EDITOR**GRÉGOIRE HENNEBERT**

32 Rue de l'Élevage

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Bresadola's polypore collection at the Natural History Museum of Trento, Italy

TATIANA BAPTISTA GIBERTONI

tbgibertoni@hotmail.com

Università degli Studi di Bologna (a/c A. Bernicchia)

Viale Fanin 42, 40127, Bologna, Italy

ANNAROSA BERNICCHIA

abernicc@agrsci.unibo.it

Università degli Studi di Bologna

Viale Fanin 42, 40127, Bologna, Italy

LEIF RYVARDEN

leif.ryvarden@bio.uio.no

University of Oslo

P.O. Box 1066 Blindern, N-0316, Oslo, Norway

Abstract—From June 2004 to December 2005, 735 polypore specimens from the Bresadola's collection at the Natural History Museum of Trento (TR) were revised, representing 237 species including previously assumedly lost type specimens of *Favolus balansae* and *Polyporus hypomiltinus*. Parts of the types of *Polyporus flavidus* and *Polyporus bartholomaei* were recovered and the combination *Perenniporia bartholomaei* is proposed.

Key words—polypore types, *Trametes lilacea*, *Polyporus flaccidus*, *Poria longispora*

Introduction

Abbé Giacomo Bresadola was an Italian mycologist who worked in the end of the 19th and beginning of the 20th century in the province of Trento, near the Austrian border. Although leaving Italy just once for a short scientific trip in Albania and never leaving the Trento region again (Bauer 1979), he received mycological specimens from all over the world and kept a private herbarium with more than 30,000 exsiccates. Around 25,000 of these were sold to the Royal Natural Museum of Stockholm, now **Swedish Museum of Natural History** (S), in 1920 (Lazzari 1982, Bellù 1999), but some specimens can also be found in Beltsville (BPI), Berlin (B), Cambridge (FH), Kew (K), Leiden (L), New York (NY) and Paris (PC). Almost all types of the new polypores he described, now

mostly in S, were studied by Ryvarden (1988) who accepted 46 out of the 149 new species. In 1984, the Bresadolian herbarium kept at TR (Natural History Museum of Trento) was rediscovered (Bellù & Donini 1986) and, in 1995, Bernicchia (1997) started the revision of the *Aphyllphorales* exsiccates.

Results

The polypore collection at TR consists of 735 exsiccates, representing 237 species including presumed lost types of *Favolus balansae* (= *Polyporus tenuiculus*) and *P. hypomiltinus* (= *Amylosporopus campbellii*). Isotypes of *Polyporus bartholomaei* (= *Perenniporia bartholomaei* comb. nov.) and *P. flavidus* were also recovered in TR. Comments on three unpublished species and on *Trametes lilacea* are also given.

The species are followed by the herbarium number and sampling location (between parentheses). The nomenclature was updated according to the CABI and CBS databases and the herbarium abbreviations follow Index Herbariorum (2005).

Favolus balansae Bres., Stud. Trent., ser. 2 7: 8 (1926)

(type B4527, B4471, Santa Ana, Misiones, Argentina)

= *Polyporus tenuiculus* (P. Beauv.) Fr.

Both collections are in good condition and have well preserved basidiospores, basidia and hyphae; B4527 includes a Latin description and “type” written on the label, which indicates it to be the lost type of *Favolus balansae* Bres. (see Ryvarden 1988). Although validly published, it is an illegitimate name being a homonym of *Favolus balansae* Speg., Revue mycol. (Toulouse) 11: 94 (1889) (= *Echinochaete brachypora* (Mont.) Ryvarden).

Polyporus bartholomaei Peck, Bull. Torrey bot. Club 23: 418 (1896)

(B1924, Stockton, Kansas, USA)

= *Perenniporia bartholomaei* (Peck) Gibertoni & Bernicchia, comb. nov.
(Basionym as cited above.)

On the label it is stated “part of the type”, besides there is a short description of the material, and collection data. The holotype of *P. bartholomaei* (BPI 203625) was examined and shown to be identical to the holotype of *Polyporus semistipitatus* Lloyd (BPI 306519), also collected in Stockton and examined. *Polyporus bartholomaei* has priority over *Polyporus semistipitatus*.

Polyporus hypomiltinus Bres., Symb. Sinica 2: 45 (1937)

(B2097, Likiang-hsien [Lijiang], Yunnan, China)

= *Amylosporopus campbellii* (Berk.) Ryvarden

This is selected as a lectotype of *Polyporus hypomiltinus* (designated here). The original collection apparently is lost: it is missing from the herbarium of

the University of Vienna (WU) [where it should have been filed as Handel-Mazzetti 12927 (Dr. Walter Till, pers. comm.)] and no specimen can be found W (Dr. Uwe Passauer, pers. comm.).

Trametes lilacea Bres., Bol. Acad. Nat. Ci. (Cordoba) 28: 388 (1926)

(B3950, isotype B4492, Argentina).

Accepted species. Basidiomes pileate, effused-reflexed; sterile surface glabrous, zonate, ochraceous darkening to vinaceous towards the margin, with lilac tint; pore surface pinkish; pores round to angular, 2-3 per mm; context ochraceous, darkening permanently in KOH, 1 mm thick; tube layer concolorous with the context and also darkening permanently in KOH. Hyphal system trimitic, generative hyphae clamped, 2.4-3.5 μm ; skeletal hyphae 3.6-4.8 μm ; binding hyphae 2.4-2.8 μm ; basidia 25 x 7-8 μm ; basidiospores cylindrical to fusiform, 7-11.2 x 3.3-4 μm . The label of B4492 has the following statement: "8, *Trametes lilacea* n. sp., sporae $\emptyset$; hyphae hym. ??? 1 $\frac{1}{2}$ - 4 μ ; pilei 2-4 $\frac{1}{2}$??? pallido, Argentina, Dr. Spegazzini", information partially repeated in B3950. The latter is apparently a part of B4492 since on its pilei it is written "8" as on the label of B4492.

Trametes lilacea was published with a Spanish description:

Hab. Sobre palos de alambrados em los alrededores de Tucumán, octubre 1918; *Obs.* Especie que es muy próxima al *Trametes argyropotamicus* Speg., del cual difiere por el color violeta pálido de su sombrero, mientras el himenio ostenta una coloración blanco rosada; no existen cerdas himeniales; las esporas son elítico-ovaladas (5-6,5 X 2,5-3 μ), lisas e incoloras.

The holotype is in LPS (30510) but it was not examined.

Besides the species mentioned above, three unpublished species were also found and are discussed below.

Polyporus flaccidus Bres.

(B1948, B2076, Missouri, USA)

= *Phaeolus schweinitzii* (Fr.) Pat.

No mention of *P. flaccidus* Bres. was found in the literature. The label of B1948 has the following information: "*Polyporus flaccidus* Bres. n. sp.; ad truncos, Missouri, n.863", measurements, drawings of basidiospores and of the basidiome. On the label of B2076, part of these data is repeated. No further information was found about this species; *Polyporus flaccidus* Bres. is apparently an unpublished name. If validly published, it would be illegitimate as a later homonym of *Polyporus flaccidus* Pers.

Polyporus flavidus Peck

(B1951, USA)

= unknown identity, poor material

On the label of this material it is written "part of the type" and the number 18732, a short description in Latin, a drawing of two basidiospores, and

collection data (Worcester, NY, leg. Peck). Another isotype is deposited at BPI (208676) and on the label it is stated that there is an additional collection in NYS, originally from the herbarium of James Weir, number 18732. *Polyporus flavidus* is an unpublished name and its true identity is unknown.

***Poria longispora* Burt**

(B4417, USA)

= *Phellinus* sp., poor and contaminated material.

The label states this to be a new species by Burt but the name is absent in the literature and the databases we have consulted. The collection includes a Latin description and drawings of the basidiospores. It was collected in Montgomery, Alabama, in 1916 and is a part of the Weir collection.

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Notes on taxa of the genus *Pholiota* described by C. Kalchbrenner

SLAVOMÍR ADAMČÍK¹, JAN HOLEC², PAVEL LIZOŇ¹,
SOŇA RIPKOVÁ³ & VIKTOR KUČERA¹

¹slavomir.adamcik@savba.sk, pavel.lizon@savba.sk, viktor.kucera@savba.sk
Institute of Botany, Dept. of Cryptogams
Dúbravská 14, SK-845 23 Bratislava, Slovakia

²jan_holec@nm.cz
National Museum, Dept. of Mycology
Václavské nám. 68, CZ-115 79 Praha 1, Czech Republic

³ripkova@fns.uniba.sk
Comenius University, Faculty of Natural Sciences, Dept. of Botany
Révová 39, SK-811 02 Bratislava, Slovakia,

Abstract—Taxa of the genus *Pholiota* described by C. Kalchbrenner – all of them described from the area of present day Slovakia – are revised and identified. *Agaricus decussatus* subsp. *illustris* is conspecific with *Pholiota lubrica*, and *Agaricus punctulatus* represents *Pholiota gummosa*. The specimen collected from the area of the type locality is designated as epitype for *Agaricus decussatus* subsp. *illustris*. The identity of *Agaricus filamentosus* subsp. *lampas* and *Agaricus filamentosus* subsp. *lepturus* cannot be revised exactly because no original herbarium material is available, but both taxa certainly represent either *Pholiota adiposa* or *P. limonella*. Kalchbrenner's illustrations are designated as lectotypes for all four taxa.

Key words—nomenclature, typification

Introduction

Carl Kalchbrenner (1807–1886) was one of the first mycologists studying fungi in the area of present day Slovakia. He settled in Spišské Vlachy (Szepes Olaszi in Hungarian, Wallendorf in German), northern Slovakia in 1832. He served there as an evangelical priest and studied fungi until his death (Lizoň 1992). In his monograph of the fungi of the region Spiš “A Szepesi gombák jegyzéke” (Kalchbrenner 1865, 1868) and in the iconography of the Hymenomycetes of Hungary (which also included Slovakia at that time), he described numerous new fungal taxa (Kalchbrenner 1873, 1874, 1875, 1877). A full list of Kalchbrenner's new taxa was published by Lizoň (1992, 1997) and some of them were commented on later by Lizoň & Jančovičová (2000).

The goal of our project is to revise Kalchbrenner's "forgotten" taxa with respect to current taxonomic concepts and to check the nomenclatural status of his names.

Kalchbrenner described four taxa that are members of the genus *Pholiota* in its current delimitation, as *Agaricus (Pholiota) filamentosus* subsp. *lepturus* (Kalchbrenner 1868), *Agaricus (Pholiota) filamentosus* subsp. *lampas* (Kalchbrenner 1868), *Agaricus (Flammula) decussatus* subsp. *illustris* (Kalchbrenner 1874) and *Agaricus (Pholiota) punctulatus* (Kalchbrenner 1874). Although part of his herbarium is preserved in BP and BRA, original or type specimens of the above listed taxa are missing (Lizoň 1997) and no lectotypes or neotypes have been designated until now. Two of these taxa have already been revised by Holec (2001).

Material and methods

Macroscopic characters of the proposed epitype were observed in fresh material. Colours of basidiocarps were compared with Kornerup & Wanscher (1978) and are noted in parentheses by appropriate code. Micromorphological characters were observed in dried material using a light microscope with oil immersion lens. Fragments of lamellae, stipe and pileipellis were examined in 5% KOH, Melzer's reagent, and a solution of Congo Red in ammonia (1 ml of 25% ammonia dissolved in filtrated solution of 1.5 g of Congo Red and 50 ml of distilled water). Values of micromorphological characters are calculated as average $\pm$ standard deviation of 30 measurements. Values in parentheses are extremes. Abbreviations of herbaria are cited in accordance with Index Herbariorum (Holmgren et al. 1990). The location of collecting sites is presented by geographical coordinates and quadrant (Q) of the Central European grid mapping system (UTM).

Results

Agaricus decussatus subsp. *illustris* Kalchbr., Icon. Select. Hymenom. Hung. fasc. 2: 26, 1874

Identity — *Pholiota lubrica* (Pers.: Fr.) Singer (= *Agaricus decussatus* Fr. subsp. *decussatus*).

Original collecting site — "In silvis montanis Scepusii, ad truncos Pinuum et in vicinia eorum, sed etiam procul ab iis, locis udis, graminosis, ad terra, haud frequens. Octob." [Northern Slovakia, region of Spiš]

Lectotype — Kalchbrenner, Icon. Select. Hymenom. Hung. fasc. 2: pl. 15, fig. 1, 1874; designated here.

Epitype — Slovakia, Galmuská planina (Slovenské rudohorie Mts.), National Nature Reserve Červené skaly near the village of Poráč, alt. 432 m, geografic position 20°46'08"E, 48°52'47"N, Q 7190b, gregarious and in clusters on decaying wood of conifers and on



Fig. 1. *Agaricus decussatus* subsp. *illustris* – epitype: a. cystidia, b. spores (bars = 10 μ m).

litter, under *Picea abies* and *Corylus avellana* in stream flood area, 26 Sept.2004, S. Adamčík & al. (SAV 1225); **designated here**.

Description of the epitype (Fig. 1) — Pileus 32-70 mm diam., first hemispherical, later obtusely conical, expanding to plano-convex to almost plane when mature, later sometimes with indistinct obtuse broad umbo, with inflexed margin, not hygrophanous, not translucently striate, surface strongly glutinous, smooth, innate radially fibrillose (fibrils darker than background) towards centre, cream to light yellow at margin, (4A3-4A4), towards the centre orange yellow (4B5) and more orange, centre light brown to cocoa brown (6D7, 6E6), sometimes almost to margin dark red brown (young basidiocarps), with white fibrillose-floccose scales of veil on margin when young. Stipe 50-90 $\times$ 4-13 mm, clavate to subbulbose, with white rhizoids on the base, solid when young, in young stage

connected with margin of pileus by white cortina leaving later indistinct ring zone, above ring zone almost smooth, below it with white and later brownish fibrillose scales, base more brown to dark red-brown. Lamellae 3-6 mm wide, moderately distant, $L = 40-50$, $l = 3-7$, adnexed or decurrent with tooth, greyish ochre (young fruitbodies), edge irregular, concolorous, later paler. Context pale ochraceous in pileus, dark red-brown in base of stipe, with indistinct smell reminding *Pholiota squarrosa*, taste slightly bitter. Spore print dark brown.

Spores $(5.6-6-6.7(-7.5) \times (3.1-3.2-3.6(-4) \mu\text{m}$, av. $6.3 \times 3.4 \mu\text{m}$, $Q = (1.5-1.7-2(-2.3)$, av. $Q = 1.9$, ellipsoid or ovoid, distinctly phaseoliform from side view, thick-walled, germ pore small, wall brownish ochre to brownish yellow. Cheilocystidia and pleurocystidia of the same size and shape, both abundant, $(42-45.5-54.5(-59) \times (11.5-12.5-15(-16.5) \mu\text{m}$, av. $50 \times 13.5 \mu\text{m}$, mostly lageniform, rarely fusiform or clavate, usually with long narrow stipe-like base and conical or cylindrical apical neck that is sometimes subcapitate; cell walls usually thickened in inflated part, hyaline or filled with yellow pigment, sometimes with yellow incrustation on terminal part. Pileus cuticle an ixocutis, stipe cuticle a cutis; clamp connections present in all tissues.

Notes — According to ICBN (Greuter et al. 2000), epitypes can be designated to support types that are ambiguous and cannot be critically identified for purposes of the precise application of the name of a taxon. Although the lectotype (illustration by Kalchbrenner) is very good, it cannot serve for study of microcharacters, which are very important in fungi. Consequently, the epitype (herbarium specimen) is designated here to make a “full picture” of the taxon in question.

The epitype specimen was found on wood lying on soil under *Picea abies* and *Corylus avellana*. It was collected in the flood area of the Poráčský potok Stream and that is why the substrate could include also wood of other nearby growing trees, such as *Abies alba*, *Pinus sylvestris* and *Fagus sylvatica*. Holec (2001) listed *Abies*, *Acer*, *Betula*, *Fagus sylvatica*, *Picea abies* and *Quercus* as substrates for *Pholiota lubrica*.

Kalchbrenner reported *Agaricus decussatus* subsp. *illustris* from the stumps of *Pinus* and their vicinity so the substrate might include also remains of wood of other trees. Even if his description of the habitat is vague, characters shown in the illustration and noted in the original diagnosis match with those of *Pholiota lubrica*: distinctly fibrillose-scaly surface of the stipe, innate radial darker fibrils on pileipellis, paler yellow colour of pileus margin contrasting to darker orange brown centre, disappearing fibrillose-floccose veil on margin of pileus.

Most of Kalchbrenner's herbarium specimens were lost or destroyed during 19th century and only a small part of his herbarium has survived in BP and BRA (Lizoň 1992, 1994). The only available original material for the selection of the type is Kalchbrenner's illustration (ICBN Art. 9.1 Note 1). His notes on

ecology and collection site helped also for designation of that illustration as lectotype (ICBN Art. 9.2). Our collection designated as epitype was collected in a similar habitat to that described by Kalchbrenner (moist place, soil and decaying wood of conifers) and the collecting site is located also in the region of Spiš. All macromorphological characters of the epitype agree with the original description of the fungus.

Kalchbrenner's description of *Agaricus decussatus* subsp. *illustris* is based on robust fruitbodies with bright coloured pileus. He noted that the fungus has similar characters with *Agaricus decussatus* Fr. (finely radially innate darker fibrils) and therefore he treated it as a subspecies of the later. The taxon was proposed without specified rank as "*Agaricus Flammula decussatus* Fr. * *illustris* Kalchbr." but at the end of the protologue Kalchbrenner specified that it is a subspecies of *Agaricus decussatus*.

Some authors (Moser 1978, 1983, Breitenbach & Kränzlin 1995) have distinguished *Pholiota decussata* and *Pholiota lubrica* by the saturation of color (besides of spore size and ecology). The monograph of the genus *Pholiota* (Holec 2001) considers *Pholiota decussata* a taxon falling within the variability of *Pholiota lubrica*, which is a rather variable species. Our team agrees with this solution and, consequently, considers *Agaricus decussatus* subsp. *illustris* identical and thus synonymous with *Pholiota lubrica*.

Agaricus punctulatus Kalchbr., Icon. Select. Hymenom. Hung. fasc. 2: 25, 1874.

Identity — *Pholiota gummosa* (Lasch: Fr.) Singer

Original collecting site — "In solo humoso, graminoso, ad margines Pinetorum Olasziensium prope rivulum vallis Kondratka; unico saltem loco, sed ibi jam per plures annos repertus. Nunquam in truncis nascentem vidi, semper vero ramentis sub terra putrescentibus adhaeret. Sept. Oct." [Slovakia, valley Kondrátka near the town of Spišské Vlachy].

Lectotype — Kalchbrenner, Icon. Select. Hymenom. Hung. fasc. 2: pl. 14, fig. 2, 1874; designated here.

Notes — Holec (2001) was of the opinion that Kalchbrenner's description and illustration of *Agaricus punctulatus* represents *Pholiota gummosa*. He stressed that the illustration by Kalchbrenner is a perfect drawing of *P. gummosa* with a slight olive tinge (a typical character), although this tinge is not mentioned in the protologue. We agree with this conclusion here.

Agaricus filamentosus subsp. *lampas* Kalchbr., Math. Terméztud. Közlem. 5[1867]: 232, pl. 1, fig. 4, 1868.

Identity — *Pholiota adiposa* (Batsch: Fr.) P. Kumm. or

Pholiota limonella (Peck) Sacc.

Original collecting site — "Szepes, Igen árnyas fenyvesek sájátja" [Northern Slovakia, region of Spiš, in very shadowy conifer woods].

Lectotype — Kalchbrenner, Math. Terméztud. Közlem. 5[1867]: pl. 1, fig. 4, 1868; designated here.

Notes — The main diagnostic characters of *Agaricus filamentosus* subsp. *lampas* are the following: Pileus 3.7-5 cm, plano-convex, at first with involute margin, viscid, with indistinct and rare scales that are glutinous, or they are disappearing and the surface is naked, colour of background golden yellow-fulvous. Lamellae watery-argillaceous, then cinnamon-brown. Stipe 5-7.5 × 0.6-0.8 cm, cylindrical with slightly thickened lower part and acute rooting base, at first solid, then hollow, elastic, fibrillose, yellow, with upright, cortinate-floccose, striate annulus which breaks easily, above the annulus paler, naked or yellow punctulate, below the annulus with adpressed floccose scales or subsquarrose. Context white-yellowish. Odour indistinct, by no means pleasant. Kalchbrenner (1968) wrote that the fungus resembles *Agaricus adiposus* but differs by thinner stature in all parts and almost non-viscid stipe.

According to the original description and illustration (lectotype), the taxon clearly belongs to *Pholiota* sect. *Adiposae* Konrad & Maubl. ex Holec, which is characterized by medium-sized to large fruitbodies with scaly and viscid to glutinous pilei (Holec 2001). However, it is impossible to identify *A. filamentosus* subsp. *lampas* without study of micromorphological characters, especially size of spores and shape of cheilocystidia. The fungus was collected in shadowy coniferous forest. The habitat does not agree with that of *Pholiota cerifera* (P. Karst.) P. Karst. that is almost exclusively found on wood of *Salix*. From other species of section *Adiposae*, the description and illustration fit either to *Pholiota adiposa* (sensu Fries 1821, Jacobsson 1987, Holec 2001; non *P. adiposa* sensu Ricken, Konrad & Maublanc, J.E. Lange, Kühner & Romagnesi, Moser, etc. = *P. jahnii*) or to *Pholiota limonella*. Both *P. adiposa* and *P. limonella* grow on wood of conifers and are known from Slovakia (Holec 2001). However, both species are almost identical macroscopically and are delimited only by a slight difference in spore size (Jacobsson 1987, Holec 2001). Consequently, the exact identity of *A. filamentosus* subsp. *lampas* remains unclear but the fungus certainly represents either *Pholiota adiposa* or *P. limonella*.

Agaricus filamentosus subsp. *lepturus* Kalchbr., Math. Terméztud. Közlem. 5[1867]: 232, pl. 1, fig. 3, 1868.

Identity — *Pholiota adiposa* (Batsch: Fr.) P. Kumm. or
Pholiota limonella (Peck) Sacc.

Original collecting site — “Szepes, Fenyőtuskókon, verőfényes helyiségeken” [Northern Slovakia, region of Spiš, on pine stumps in sunny places]

Lectotype — Kalchbrenner, Math. Terméztud. Közlem. 5[1867]: pl. 1, fig. 3 1868; designated here.

Notes — The main diagnostic characters of *Agaricus filamentosus* subsp. *lepturus* are the following: Pileus 2.5-7.5 cm, thick-fleshed, convex, yellow-brown- to

orange-brown, distinctly viscid, surface broken into scales which are denser at the centre and subimbricate to fibrillose towards the margin, adpressed, later flattened and scattered. Lamellae at first pale, then waterish cinnamon-brown. Stipe 2.5-5 × 0.4-0.6 cm, in basal part up to 0.6-0.8 cm, truncate at the base but with a thin radicate protuberance, whitish-yellowish, fibrillose-striate, towards the base broken into scales, dark yellow-brown at maturity, with floccose and disappearing annulus. Context yellowish. Odour indistinct, pleasant. Taste not distinctive. Kalchbrenner (1868) wrote that its scaly pileus resembles *Agaricus heteroclitus* but that fungus has the odour of *Armoracia*, thick and white stipe and is a different species.

The discussion on *Agaricus filamentosus* subsp. *lepturus* could be almost the same as in the case of the previous taxon (see above). Considering general habit of its basidiocarps, especially its scaly and viscid pileus, the taxon belongs to *Pholiota* sect. *Adiposae*. The illustration (lectotype), especially the subimbricate scales on the pileus surface, strongly resembles *Pholiota cerifera*, but the substrate (pine stumps) is atypical for it. Consequently, *Agaricus filamentosus* subsp. *lepturus* represents either *Pholiota adiposa* (sensu Fries 1821, Jacobsson 1987, Holec 2001; non *P. adiposa* sensu Ricken, Konrad & Maublanc, J.E. Lange, Kühner & Romagnesi, Moser, etc. = *P. jahnii*) or *Pholiota limonella* (for detailed discussion see the previous taxon). Kalchbrenner mentioned that the description and illustration represent a fruitbody collected from exposed places. At such places, basidiocarps of *Pholiota* have usually darker colours and more distinct and darker scales than those collected in shadowy places and moist conditions when the scales are covered by slime. The character of scales in dry conditions is in agreement with the appearance of *A. filamentosus* subsp. *lepturus* on plate 1, fig. 3. Finally, it is impossible to decide without study of spore size if *Agaricus filamentosus* subsp. *lepturus* represents either *Pholiota adiposa* or *P. limonella* (see also the discussion above).

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Studies on the genus *Paecilomyces* in China IV. Two new species of *Paecilomyces* with monophialides

ZONGQI LIANG^{*} ¹ YANFENG HAN¹

& HUALI CHU²

^{*}*zqliang472@yahoo.com.cn* *swallow112886@yahoo.com.cn*

¹*Institute of Fungus Resources, Guizhou University
Guiyang 550025, China*

huali1121@163.com

²*Hainan University, Haikou 570228 China*

Abstract—Two new monophialidic species of *Paecilomyces*, *P. furcatus* and *P. cinereus*, were isolated and discovered from soils of Shandong and Hebei Provinces, respectively, in China. Characters common to the two new species are as follows: [1] Optimum growth temperatures are 40°C. [2] Conidiophores are absent or very simple. [3] Phialides arise solitarily from the aerial hyphae. Phylogenetic analysis of the rDNA ITS region suggest that both new species *P. furcatus* and *P. cinereus* form a separate sub-clade within a clade also containing *P. inflatus*, *P. biformis* and *P. crassosporus*.

Key Words—fungi, hyphomycetes, morphology, taxonomy

Introduction

In 1967, a section of monophialidic species in the genus *Paecilomyces* was put forward by Onions & Barron. This section included those species whose main axes of conidiophores were absent and phialides arose solitarily from vegetative hyphae or 2–3 phialides on short and simple conidiophores. It is an unfortunate that, however, they neglected the basal character of the genus *Paecilomyces* and put some species with awl-shaped phialides into this section (Onions & Barron 1967). Subsequently, Gams (1971) removed most species of the section into the genus *Acremonium* and only one species, *P. inflatus* (Burnside) J.W. Carmich. remained in genus *Paecilomyces*. This species has phialides with globose to ellipsoidal inflated bases and simple conidiophores.

So far, there are six typical monophialidic species, *P. inflatus* (Samson 1974), *P. ampullaris* Matush. (Matushima 1971:42), *P. ampulliphorus* Matush.

Corresponding author: Zongqi Liang

(Matushima 1975:104), *P. iriomoteanus* Matush. (Matushima 1975:105), *P. major* (Liang et al.) Z.Q Liang, H.L. Chu & Y.F. Han (Chu et al. 2004, Liang et al. 2006b), and *P. bififormis* Z.Q. Liang, H.L. Chu & Y.F. Han (Chu et al. 2004, Liang et al. 2006a) in the genus *Paecilomyces*. In this paper we report and illustrate two additional new species with monophialides.

Materials and methods

Sample collection and strain isolation

Strains GZDXIFR-H104-1 and GZDXIFR-H57-1 were isolated from soil samples from Yantai, Shandong Province and Tangshan, Hebei Province. Two grams of soil were added to a flask containing 20ml sterilized water and glass beads. Each soil suspension was shaken for about 10min and then diluted to concentrations of 10^{-1} - 10^{-2} . One ml suspension (10^{-2}) was mixed with Martin medium in a sterilized 9cm diam. Petri dish and incubated at 40°C for 4 days.

Strain identification

The studied strains were transplanted on Czapek agar, potato dextrose agar (PDA) and Sabouraud agar. After incubation at 40°C for 7 days, these strains were identified based on colony character, conidiogenous structures and biology according to Brown & Smith (1957) and Samson (1974).

Reagent and DNA extraction

Taq enzyme and dNTP are bought from Shanghai Sangon, Agarose Gel DNA Purification kit ver 2.0 was bought from TRKARA Company.

Two strains from soils of Shandong and Hebei Provinces used for the molecular identification were incubated on Czapek agar and potato dextrose agar. Subsequently, the fresh sporulating cultures were used for DNA extraction according to Tigano-Milani et al. (1995), and then DNA was stored at -20°C.

PCR amplification and determination of ITS rDNA sequencing

Polymerase chain reaction (PCR) amplification was performed according to the manufacturer's instructions. 50μL reaction system: 10 × reaction buffer 5 μL, dNTP 1μL, primer ITS4 1μL, ITS5 1μL, Pfu buffer 0.5 μL, 2μL of template DNA and ddH₂O 39.5 μL. The amplification program : a first step of 94°C for 5 min; then 35 cycles consisted of 94°C for 40 s, 49°C for 40 s, and 72°C for 1 min; and a final step of 72°C for 10 min. To amplify ITS1-5.8S-ITS2 rDNA sequence, the following primers were used: ITS5 (5'-GGTGAGAGATTCTGTGC-3') and ITS4 (5'-TCCTCCGCTTAT TGATATGC-3'). PCR products were purified using Agarose Gel DNA Purification kit ver 2.0 according to its procedure (TRKARA Company), 1μL purification product were determined in ρ=1%

Table 1. Strains used in the molecular study

Species	Strain	GenBank No.
<i>Aphanoascus cinnabarinus</i>		AY753349
<i>Byssoscllamys fulva</i>		AY753341
<i>Byssoscllamys nivea</i>		AY753339
<i>Chaetomium globosum</i>		AY429054
<i>Chaetomium nigricolor</i>		AJ458185
<i>Cordyceps takaomontana</i>		AY624198
<i>Corynascus verrucosus</i>		AJ224203
<i>Isaria japonica</i>		AY624200
<i>Paecilomyces aeruginus</i>		AY753346
<i>P. amoeneroseus</i>		AY624168
<i>P. biformis</i>	GZDXIFR-H28, China	DQ191963
<i>P. cateniannulatus</i>		AY624172
<i>P. cateniobliquus</i>		AY624173
<i>P. cicadae</i>		AY624175
<i>P. cinereus</i>	GZDXIFR-H57-1, China	DQ243694
<i>P. coleopterorum</i>		AY624177
<i>P. crassosporus</i>	GZDXIFR-H57-2, China	DQ243696
<i>P. farinosus</i>		AY624181
<i>P. fumosoroseus</i>		AY624183
<i>P. furcatus</i>	GZDXIFR-H104-1, China	DQ243695
<i>P. inflatus</i>		AB099943
<i>P. tenuipes</i>		AY624195
<i>P. variotii</i>		AY753337
<i>Talaromyces leycettanus</i>		AY753342
<i>Thielavia hyrcaniae</i>		AJ271581
<i>T. rapa-nuensis</i>		AJ271580
<i>T. terricola</i> var. <i>minor</i>		AJ271582

Agarose by electrophoresis and sequenced with the above primers by Beijing Sunbiotech Co. Ltd. The rDNA ITS1-5.8s-ITS2 regions of two strains were submitted to GenBank (DQ243694, DQ243695).

Sequence alignment and phylogenetic analysis

Table 1 listed stains used in the molecular study. These ITS1-5.8S-ITS2 region nucleotides sequences of representative species of *Paecilomyces* and other genera were obtained from Genbank database. The sequences of two new species were aligned using the ClustalX1.83 computer programme for multiple sequence alignment and manually corrected. Then the phylogenetic tree was constructed by neighbor-joining method of MEGA version 3.1 (Kumar, Tamura, Nei 2004). Confidence values for individual branches were determined by bootstrap analysis (1000 replications).

Results

Descriptions

***Paecilomyces furcatus* Z.Q. Liang, H.L. Chu & Y.F. Han sp. nov.**

Figs. 1-3

In agar Czapekii, coloniae 25 mm diam in 7 diebus ad 40°C, planae humiles. Hyphis septatis, hyaline, lzecibus, 1.2-3.5 µm crassis. Conidiophora simplicia. Phialides singulares, 4.0 - 20.1 × 1.8 - 4.5 µm, e basi inflata ellipsoidea vel fusiformia, in collum distinctum apice inspissato angustatae. Conidia ellipsoidea, 4.0 - 7.9 × 1.9 - 3.9 µm

Colony on Czapek agar, attaining a diameter of 25 mm within 7 days at 40°C, round, flat, short floccose, light fulvous, yellowish zones in middle, regular in the margin. Reverse grey. Vegetative hyphae hyaline, smooth-walled, 1.2-3.5µm wide. Conidiophores simple. Phialides single, directly borne on the vegetative hyphae, sometimes clustering in small groups on the very short conidiophores. Phialides (3.7-)4.0-20.1(-23.3) × 1.8-4.5 µm, with an ellipsoidal or fusiform swollen basal portion, tapering into a distinct neck, usually proliferating in two furcations. Conidia smooth-walled, long-ellipsoidal or ovoid, (3.6-)4.0-7.9 × 1.9-3.9(-4.3) µm.

Distribution: Shandong Province, China.

Materials examined: The holotype, GZDXIFR-H104-1, was isolated by H. L. Chu from soil of Yantai, Shandong Province, China, in September, 2003.

The holotype of *P. furcatus* GZDXIFR-H104-1 and a dried plate culture of GZDXIFR-H104-1-1 on Czapek agar are deposited in the Institute of Fungus Resources, Guizhou University, China.

The species *P. furcatus* is characterized by the obvious proliferation and furcated phialides. Although *Acremonium furcatum* W. Gams is similar to *P. furcatus* in possessing furcated phialides (Gams 1971), the phialides of *A. furcatum* are more typically awl-shaped and lack inflated bases.

Monophilic species which have typical characters of *Paecilomyces* and ellipsoidal spores include *P. ampullaris*. Its phialides also proliferate but the new species *P. furcatus* differs from *P. ampullaris* by having obviously furcated phialides (Figs. 1-3) and larger conidia.

***Paecilomyces cinereus* Z.Q. Liang, H.L. Chu & Y.F. Han sp. nov.**

Figs. 4-6

In agar Czapekii, coloniae 60mm diam in 7 diebus ad 40°C planae humiles. Hyphis septatis, hyaline, lzecibus, 1.4 - 3.6 µm crassis. Phialides singulares, 4.0-20.8(-24.6) × 2.2-6.0µm, e basi inflata ellipsoidea, in collum distinctum apice inspissato angustatae, 3.0-10.1(-11.2)µm. Conidia ellipsoidea, 3.1-9.6(-13) × 1.4-4.8(-5.4)µm

Colony on Czapek agar, attaining a diameter of 60 mm within 7 days at 40°C, round, flat, short floccose, light grey zone in center; reverse dark. Vegetative hyphae hyaline, smooth-walled, 1.4-3.6 µm wide. Conidiophores simply, phialides single, directly borne on the vegetative hyphae, sometimes clustering

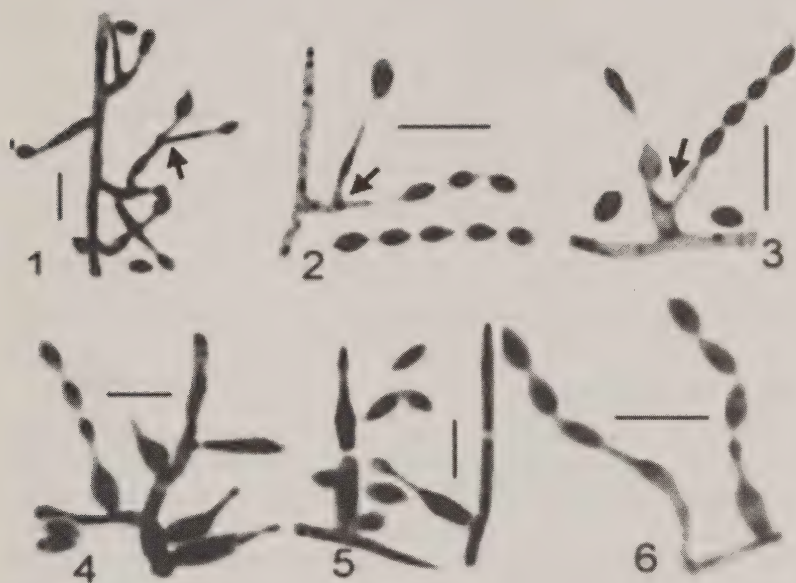


Fig. 1. Conidiogenous structures of two new species

1-3 *P. furcatus* Z. Q. Liang et al.

4-6 *P. cinereus* Z. Q. Liang et al.

Bars 1-6 = 10 μ m

in small groups on very short conidiophores. Phialides $4.0-20.8(-24.6) \times 2.2-6.0 \mu\text{m}$, with a swollen, ellipsoidal or cylindrical basal portion, tapering into a distinct neck, $3.0-10.1(-11.2) \mu\text{m}$ long. Conidia smooth-walled, long-ellipsoidal, $3.1-9.6(-13) \times 1.4-4.8(-5.4) \mu\text{m}$, in divergent long chains.

Distribution: Hebei Province, China.

Materials examined: The holotype, GZDXIFR-H57-1 was isolated by H. L. Chu from soil of Tangshan, Hebei Province, China, 2003.8.

The holotype of *P. cinereus* GZDXIFR-H57-1 and a dried plate culture of GZDXIFR-H57-1-1 on Czapek agar are deposited in the Institute of Fungus Resources, Guizhou University.

At present, among six monophialidic species reported hitherto (Matushima 1971:42, 1975, Samson 1974, Chu et al. 2004, Liang et al. 2006a), the fungus *P. cinereus* can be distinguished from the other species by grey colony, black reverse and longer ($13 \mu\text{m}$) conidia (Table 2). The above characters are closely similar to *P. biformis*, however, the latter species can be distinguished from *P. cinereus* by its dimorphic conidiogenous structure and rough conidiophore.

Table 2. A comparison of morphological characteristic of *P. cinereus* with allied species

Species	Colonies	Phialides	Conidia (µm)
<i>P. cinereus</i>	Grey, reverse dark	Ellipsoidal or cylindrical	Long-ellipsoidal 3-13×1.4-5.4
<i>P. furcatus</i>	Grey-brown, reverse grey	Ellipsoidal, furcate	Long-ellipsoidal 3.6-7.9× 1.9-4.3
<i>P. biformis</i>	Grey-brown, reverse dark	various	Ellipsoidal fusiform 4.5-13×3.5-7

Molecular Identification

Based on the phylogenetic relationships analysis derived from partial large subunit (LSU) and partial small subunit (SSU) rRNA gene sequences of *Paecilomyces* spp., *Verticillium* spp. and *Beauveria* spp., Obornik et al. (2001) proposed that the genus *Paecilomyces* was polyphyletic. Subsequently, phylogenetic relationships of the genus *Paecilomyces* were more studied by Luangsa-ard et al. (2004, 2005). Their results showed that the monophialidic species, *P. inflatus* had a more closed affinity with *Sordariales*, but it could not be linked with other mesophilic species with hypocrealean affinities.

A result of Blast in GenBank based on the ITS1-5.8S-ITS2 region showed that several monophialidic *Paecilomyces* species including the fungus *P. inflatus* had higher identities with some ascomycetes and were classified in the order *Sordariales* (clade III) (Fig.2). The reconstruction of the phylogenetic tree inferred from the analysis of the ITS1-5.8S-ITS2 region showed that both new species GZDXIFR-H57-1 and GZDXIFR-H104-1 are clustered together with the sister groups in the same clade III, which groups consist of both monophialidic species *P. biformis* H28-1 and *P. crassosporus* H57-2 as well as other ascomycetes. But two new species formed an unispecific sub-clade in the clade III (Fig.2). Morphologically, the anamorphs of some ascomycetes in clade III are also different from the two new species by dark hyphae and terminal aleuriospores (Kiffer & Morelet, 1997).

P. inflatus is similar to the two new species in morphology, but it can be separated by the fusiform conidia. The molecular evidence showed that the fungus *P. inflatus* formed a separate branch in clade III (Fig.2), further supporting its distinctness.

Some entomogenous and thermotolerant species of the genus *Paecilomyces* were aggregated in clade II and clade I (Fig.2). They had affinities for *Hypocreales* (*Clavicipitaceae* and *Hypocreaceae*) and *Eurotiales* (*Trichocomaceae*).



Fig.2. Phylogenetic tree based on the neighbour-joining method of representative of *Paecilomyces* spp. inferred from the ITS1-5.8S-ITS2 rDNA region. Bootstrap values calculated from 1000 replicates indicated at the branches.

The fungus *Acremonium furcatum* is similar to the new species *P. furcatus* in possessing furcated phialides. The phylogenetic analysis (Fig.2) demonstrates phylogenetic separation of *A. furcatum* from *P. furcatus* and *P. cinereus*.

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Three new species of *Corynespora* from Indonesia

NILAM F. WULANDARI

wulandari_nilam@yahoo.com

Microbiology Division, Research Center for Biology, LIPI

Jl. Ir. Juanda 18 Bogor, West Java, Indonesia

Abstract—*Corynespora hamata*, *C. acalyphae* and *C. gracilis* are described and illustrated as new species, based on collections made in Indonesia.

Key words—hyphomycetes, Java

Introduction

The concept of the genus *Corynespora* Güssow was well-established once Wei (1950) elucidated the conidiogenesis of the type species, *C. cassicola* (Berk & M.A.Curtis) C.T. Wei. Additional species have been described by many authors including Ellis (1957, 1960, 1961a,b, 1963a,b, 1971, 1976), Dyko and Sutton (1979), Morgan (1988), Siboe et al. (1999), Zhang and Ji (2005), Zhang and Shi (2005), and Zhang and Xu (2005). Conidial characters (size, shape, septations and to some extent colourations) have been used to distinguish species within the genus (Ellis 1957, 1976; Siboe et al. 1999).

In making general collections of hyphomycetes from Indonesia, three undescribed species of *Corynespora* have been found. They are described and illustrated as new species.

Taxonomic Descriptions

Corynespora hamata Wulandari, sp. nov.

Fig. 1

Coloniae limitatae, effusae, brunneae. Mycelium superficiales vel immersum, ex hyphis ramosis, septatis, pallide brunneis, laevibus, 2–3.5 μm crassis. Conidiophora pallide brunneae vel brunneae, singula, erecta, flexuosa, cylindrata, laevibus, septata, per usque ad 3–7 proliferationes successivas elongascentia, 264–462 μm longa, 8.8–11 μm crassa. Conidia singula, primo in apice conidiophori et dein proliferationes cujusque successivae oriunda, obclavata, recta, apicem hamata, laevia, pallide olivacea, 14–19 distoseptata, 158–198 μm longa, 9–11 μm crassa, basi truncata 6–8 μm lata.

Holotypus: Habitat in ramulis emortuis, Curug Nangka, Bogor, Java, 30 Marcius 2006, Nilam F. Wulandari 37 (BO 22525).



Figure 1. Conidia and conidiophores of *Corynespora hamata*

Colonies restricted, effused, brown. *Mycelium* superficial or immersed, composed of branched, septate, pale brown, smooth-walled hyphae, 2–3.5 µm wide. *Conidiophores* single, pale brown to brown, erect, flexuous, cylindrical, smooth-walled, septate, elongating by 3–7 successive cylindrical proliferations, 264–462 µm long, 9–11 µm wide. *Conidia* formed singly through a pore at the apex of the conidiophore, which then proliferates through the apical pore and forms another conidium at the apex of the proliferation, straight, obclavate, hamate at the apex, pale olivaceous brown, smooth, 14–19 distoseptate, interspersed with 3–8 eusepta, 158–198 µm long, 9–11 µm wide, 6–8 µm at the truncate base.

Corynespora hamata is unique among species of *Corynespora* because of its crooked, pale coloured conidia. The conidiophores are exceptionally long.

***Corynespora acalyphae* Wulandari, sp. nov**

Fig. 2

Coloniae effusae, velutinae, fuscae. Mycelium superficiales vel immersum ex hyphis ramosis, septatis, pallide brunneis, laevibus, 2–3.5 µm crassis. Conidiophora pallide brunneae vel brunneae, singula, erecta, flexuosa, cylindrata, laevibus, septata, per usque ad 3–7 proliferationes successivas cylindricas elongascentia, 183–330 µm longa, 11–13 µm crassa. Conidia singula, primo in apice conidiophori et dein proliferationes cujusque successivae oriunda, recta vel curvata, obclavata, apicem attenuata, laevia, pallide brunneae vel brunneae, 8–16 distoseptata, 85–120 µm longa, 9–11 µm crassa, basi truncata 6–8 µm lata.

Holotypus: Habitat in ramulis emortuis *Acalyphae hamiltonianae*, Kotabatu, Bogor, Java, 24 April 2006, Nilam F. Wulandari 232 (BO 22529).

Colonies effused, velvety, blackish brown. *Mycelium* superficial or immersed, composed of branched, septate, pale brown, smooth-walled hyphae, 2–3.5 µm wide. *Conidiophores* single or sometimes in groups, pale brown to brown, erect, flexuous, cylindrical, smooth-walled, septate, elongating by 3–7 successive cylindrical proliferations, 183–330 µm long, 11–13 µm wide. *Conidia* formed singly through a pore at the apex of the conidiophore, which then proliferates through the apical pore and forms another conidium at the apex of the proliferation, straight or curved, obclavate, tapering to the apex, pale brown to brown, smooth, 8–16 distoseptate, interspersed with 3–8 eusepta, 85–120 µm long, 9–11 µm wide, 6–8 µm at the truncate base.

Additional specimens examined: on dead wood of *Acalypha hamiltonianna*, Kotabatu, Bogor, Java, 10 January 2006, Mien A. Rifai. s.n. (BO 22528) and 12 February 2006, Mien A. Rifai s.n. (BO 22527), 24 April 2006.

The conidia of *Corynespora acalyphae* are very similar in shape to those of *C. calicioidea* (Berk & Broome) M.B. Ellis. However, *C. calicioidea* has larger conidia that measure 50–170 µm long x 10–15 µm wide and synnematous conidiophore (Siboe et al. 1999).



Figure 2. Conidia and conidiophores of *Corynespora acalyphae*



Figure 3. Conidia and conidiophores of *Corynespora gracili*

Corynespora gracilis Wulandari, sp. nov.

Fig. 3

Coloniae effusae, fuscae. Mycelium superficiales vel immersum ex hyphis ramosis, septatis, pallide brunneis, laevibus, 2–3.5 µm crassis. Conidiophora pallide brunneae vel brunneae, singula, erecta, flexuosa, cylindrata, laevibus, septata, per usque ad 1–2 proliferationes successivas cylindricas elongacentia, 121–198 µm longa, 4–6 µm crassa.

Conidia singula, primo in apice conidiophori et dein proliferationes cujusque successivae oriunda, recta, gracile, apicem attenuata, pallide olivacea, laevia, 10–22 distoseptata, 92–138 µm longa, 5–7 µm crassa, basi truncata 4.5 µm lata.

Holotypus: Habitat in ramulis emortuis Piperis betle, Merapi Mountain National Park, Kaliurang, Yogyakarta, Java, 21 April 2006, Nilam F. Wulandari 231 (BO 22526).

Colonies effused, blackish brown. *Mycelium* superficial or immersed, composed of branched, septa, pale brown, smooth-walled hyphae, 2–3.5 µm wide. *Conidiophores* single or in groups, pale brown to brown, erect, flexuous, cylindrical, smooth-walled, septate, elongating by 1–2 successive cylindrical proliferations, 121–198 µm long, 4–6 µm wide. *Conidia* formed singly through a pore at the apex of the conidiophore, which then proliferates through the apical pore and forms another conidium at the apex of the proliferation, straight, slender, tapering to the apex, olivaceous, smooth, 10–22 distoseptate, interspersed with 1–2 eusepta, 92–138 µm long, 5–7 µm wide, 4.5 µm at the truncate base.

The slender spored *Corynespora gracilis* is similar in shape to *C. smithii* (Berk & Broome) M.B.Ellis, but the latter species has much stouter conidia measuring 70–140 µm long x 12–19 µm wide.

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A new gymnopoid species from western Spain

F. ARENAL¹, M. VILLARREAL¹ & G. MORENO²

farenal@ccma.csic.es, mvillarr@ccma.csic.es, gabriel.moreno@uah.es

¹Dpto. de Protección Vegetal

Centro Ciencias Medioambientales (CCMA-CSIC)

Serrano, 115, E-28006 Madrid, Spain

²Dpto. de Biología Vegetal (Botánica)

Fac. Biología, Universidad de Alcalá de Henares

E-28871 Madrid, Spain

Abstract—A recent collection of an undescribed gymnopoid fungus from typical Mediterranean evergreen forests of western Spain is studied and described. The new species is characterized mainly by its convex and fan shaped white pileus, pruinose stipe and globose basidiospores.

Key Words—*Agaricales*, *Gymnopus*, *Marasmiellus*, Mediterranean area, taxonomy

Introduction

The Mediterranean region comprises habitats and ecosystems composed by different types of sclerophyllous evergreen forests. The rich flora of these formations represents a privileged area for biodiversity and taxonomical studies and some new gymnopoid species have been described (Robich et al., 1994, Moreno et al. 1997, Villarreal et al. 2002, Esteve-Raventós & Ortega 2003). The new species was sampled in a relictic tertiary formation *Viburno-Prunetum lusitanicae* Ladero, characterized by the presence of several evergreen and lauroid plant species such as *Erica arborea* L., *Viburnum tinus* L., *Arbutus unedo* L., *Prunus lusitanica* L. and *Phillyrea angustifolia* L. This formation is a vestige from tertiary lauroid forest, actually restricted to the macaronesian areas (Canary Island, Azores and Madeira), and several small microhabitats in the south and west of the Iberian Peninsula.

Materials and Methods

Sections and fragments of dried material were dehydrated in water and placed in 2% KOH, Congo red and Melzer's reagent to conduct amyloid tests.

Drawings were made with the aid of a camera lucida device. Basidiospore measurements in descriptions are given as (minimum value)-(mean-2SD)-mean-(mean+2SD)(-maximum value), as well as the Q value and the total number of measurements (n), according to the recommendations of Heinemann & Rammeloo (1985).

Taxonomy

Gymnopus sphaerosporus M. Villarreal, Arenal & G. Moreno. **sp. nov.** FIGURE 1

Basidiomata dispersa, parva. Pileus usque ad 12 mm latus, initio hemisphaericus postea convexus denu plano-convexus, haud hygrophanus, translucido-striatus, plicatus, minute granuloso-pruinosis, albus. Caro tenuis. Odore saporeque indistinctis. Lamellae c. 10 stipitem attingentes, distantes, adnatae, concolores. Stipes usque ad 8 mm longus, 0.8-1.5 mm latus, excentricus vel subexcentricus, aequalis, cylindraceus, minute pruinosis, pileo concolor, basi fibrillis albis substrato affixus. Basidiosporae 7-7.95-9 x 6.5-7.54-8.5 µm, globosae vel subglobosae. Basidia 34-41 x 7-9 µm, clavata, tetrasporigera, sterigmatibus usque ad 5 µm longis praedita. Cheilocystidia 32-55 (-70) x 5-10 µm, cylindrica vel subcylindrico-flexuosa apice rotundato interdum parum capitato. Pleurocystidia nulla. Pileipellis pseudotrichodermatis, hyphis 3-8 µm latis, haud pigmentatis, pileocystidia numerosa cheilocystidiis similia. Caulocystidia 19-55 x 4-8 µm, diversiformia, descendencia ad basim. Reactio chemicalis basidiocarporum nulla pars amyloidea vel dextrinoidea. Fibulae praesentes in totus partibus carposomatum.

TYPUS: Spain, Ávila, Arenas de San Pedro, 24-XI-2004, leg. F. Arenal et M. Villarreal, ad corticem *Arbuti unedo*. (AH 31888 holotypus)

Etymology: from Latin “*sphaerae*” = due to its globose basidiospores.

Pileus 3-12 mm, at first hemispherical to convex, finally convex-flabelliform, not hygrophanus, more or less strongly plicate or wrinkled, translucent-striate, minutely pubescent, white to dirty white, pale yellowish when dry, with concolorous, even to crenulate margin. Context thin, whitish. Smell and taste absent. Lamellae c. 10, l = 0-2, distant, triangular, adnate becoming adnate-subdecurrent, with concave white edge, pruinose under lens. Stipe up to 8 x 0.8-1.5 mm, eccentric to nearly lateral, rarely central, sometimes absent, whitish, entirely pruinose, seated on a small radiating disc of silky mycelium.

Basidiospores 7-7.95-9 x 6.5-7.54-8.5 µm, Q = 1-1.05-1.15 (n=21), globose to subglobose, smooth, hyaline with abundant lipid guttules, unchanging in Melzer's reagent. Basidia 34-41 x 7-9 µm, clavate, tetrasporic, with sterigmata up to 5 µm long. Cheilocystidia 32-55 (-70) x 5-10 µm, cylindrical, straight to flexuose and multi-strangulate, sometimes apically mucronate, thin-walled, hyaline. Lamella edge heterogeneous. Pleurocystidia absent. Hymenophoral trama inamyloid and non-dextrinoid. Pileipellis a pseudotrichoderm, made up of hyphae 3-8 µm in diam, bearing terminal or integrated cylindrical to subclavate elements similar to cheilocystidia, sometimes septate. Subpellis made up of inflated elements, up to 25 µm broad. Stipitipellis a tangled trichoderm

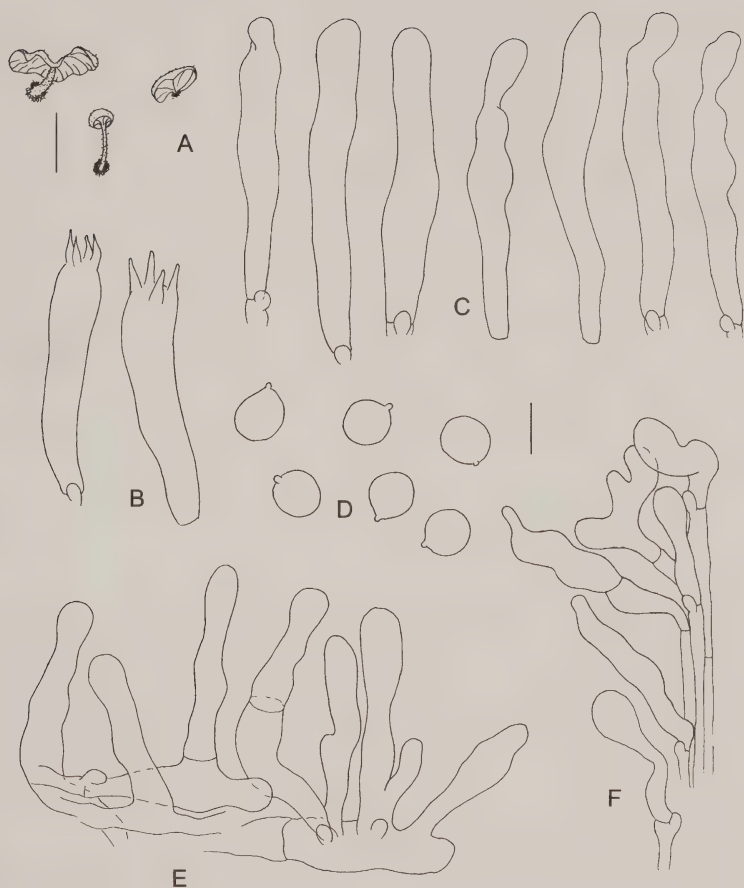


Fig 1.- *Gymnopus sphaerosporus* (AH 31888 holotype), A Habit. B. Basidia.
C. Cheilocystidia. D. Basidiospores. E. Pileipellis. F. Caulocystidia.
Bars. A: 1 cm; B-F: 10 μ m.

composed of abundant multiform caulocystidia 19-55 x 4-8 μ m. Hyphae of the stipititrama parallel up to 18 μ m broad. Clamp-connections present in all tissues.

Specimens examined: Spain, Ávila, Arenas de San Pedro, 24 Nov. 2004, F. Arenal & M. Villarreal, on decayed bark of *Arbutus unedo*. (AH 31888 holotypus)

Discussion

Gymnoid (collybioid-lentinuloid) euagarics historically have had a problematic and controversial taxonomy (Antonín et al. 1997). Recently, several works have pointed to the polyphyletic origin of *Marasmiellus* Murrill and *Gymnopus* (Pers.) Roussel (Moncalvo et al. 2000, Moncalvo et al. 2002, Mata et al. 2004, Wilson & Desjardin 2005), and stated a major clade integrated of five well-defined subclades within gymnoid euagarics. The first of them comprises species of *Gymnopus* sect. *Vestipedes* and some species of the genus *Marasmiellus*, including the type species of the genus (*M. juniperinus* Murrill). A second clade integrated by species of *Rhodocollybia* Singer together with a *Gymnopus* species; *Marasmiellus ramealis* (Bull.) Singer and *Campanella eberhardtii* (Pat.) Singer form a parallel group. A third group contains the type species of the genera *Gymnopus*, *Micromphale* Gray and *Setulipes* Antonín. The fourth clade represents the genus *Lentinula* Earle, and the fifth group limits well the resurrected genus *Mycetinis* Earle with the type species *Mycetinis alliaceus* (Jacq.) Earle (≡ *Marasmius alliaceus* (Jacq.) Fr.). A sister clade to the first major clade is dominated by members belonging to *Tetrapyrgos* E. Horak.

The new species traditionally could be placed in the genus *Marasmiellus* on account of its habit, the pileipellis tending to be a trichoderm, a stipe with poorly developed basal mycelium, inamyloid basidiospores and non-dextrinoid context hyphae. However, the actual phylogenetic considerations of the morphological characters for each phylogenetic lineage consist mainly in basidiomes with noninsititious to subinsititious stipe, inamyloid and nondextrinoid basidiospores, and pileipellis composed of a cutis of radially arranged cylindrical, nondiverticulate or weakly diverticulate hyphae which are roughened or covered with annular to zebroid brownish pigment incrustations (Wilson & Desjardin 2005). Based on these morphological characters for each phylogenetic lineage, we consider adequate the taxonomical placement of the new taxon as a member of genus *Gymnopus*.

The newly described taxon, *Gymnopus sphaerosporus*, is characterized by its convex to flabelliform white pileus, globose or subglobose basidiospores, cylindrical and flexuose cheilocystidia and pilei- and stipitipellis forming a pseudotrichoderm, as well as its particular habitat, growing on decayed bark of *Arbutus unedo*. None of the monographic contributions in Europe (Antonín & Noordeloos 1993, 1997), neither of neotropical areas (Singer 1973, 1976), Australasia (Horak & Desjardin 1994) nor North America (Desjardin 1997) of *Marasmiellus*, include a taxon similar to the new species proposed.

Singer (1973) proposed subsect. *Sphaeosporini* Singer for the neotropical species of *Marasmiellus* with broad basidiospores and a Q index between 1-1.5. In this subsection, *M. guzmanii* Singer, described from Mexico, differs from *M. sphaerosporus*, in having broad, diverticulate cheilocystidia, larger

basidiospores, and a different pileipellis structure. Another related species is *M. parlatorei* Singer, described from Argentina, differing from *G. sphaerosporus* in having larger basidiospores (8-12 x 7-11 µm) and a typical *Rameales*-structure in the pileipellis, absent in the newly described taxon here.

The most similar species described in Europe seems to be *Marasmiellus phaeomarasmiioides* G. Moreno et al. (Moreno et al. 1997), on account of the similar habit and microscopical features. However, this species differs from the new taxon by the small size of the fruitbodies and their colour which is cream-brown to greyish, as well as the different habitat. Microscopical differences between *M. phaeomarasmiioides* and *G. sphaerosporus* are shown in Table I.

Table I. Differences between *Marasmiellus phaeomarasmiioides* and *Gymnopus sphaerosporus*.

	Basidiospores (µm)	Pileipellis	Cheilocystidia (µm)	Pigmentation
<i>M. phaeomarasmiioides</i>	7-9	<i>Rameales</i> - structure	c. 35 x 7	Incrusting
<i>G. sphaerosporus</i>	7-9.5(-10)	Pseudo- trichoderm	32-70 x 5-10	Absent

Members belonging to genus *Gymnopus* (Pers.) Roussel are mainly saprotrophic, growing on leaf litter of different vegetal material; rarely of a lignicolous habitat, as occurs in the newly described species. Only *Gymnopus fusipes* (Bull.: Fr.) Gray and *G. inodorus* (Pat.) Antonín & Noordel. possess this habitat (Antonín & Noordeloos 1997), but these species distinctly differ by their macro- and microscopic features.

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Index of Lichenes Groenlandici Exsiccati fascicles I–XXX with notes on distribution of the taxa in Greenland

ERIC STEEN HANSEN

erich@snm.ku.dk

Botanical Museum

Natural History Museum of Denmark, University of Copenhagen
Gothersgade 130, DK-1123 Copenhagen K, Denmark

Abstract—The present list of lichens contains 239 lichen taxa that have been distributed from the Botanical Museum, University of Copenhagen during 1972–2005. The series, “Lichenes Groenlandici Exsiccati”, consists of 30 fascicles in all and includes lichen collections from all parts of Greenland, even high latitude, difficult-to-access arctic areas. The exsiccate has from the beginning been edited and arranged by the author of this paper. The 30 fascicles comprise the following numbers: I: 1–50; II: 51–110; III: 111–160; IV: 161–210; V: 211–260; VI: 261–310; VII: 311–360; VIII: 361–416; IX: 417–466; X: 467–500; XI: 501–550; XII: 551–600; XIII: 601–625; XIV: 626–650; XV: 651–675; XVI: 676–700; XVII: 701–725; XVIII: 726–750; XIX: 751–775; XX: 776–800; XXI: 801–825; XXII: 826–850; XXIII: 851–875; XXIV: 876–900; XXV: 901–925; XXVI: 926–945; XXVII: 946–965; XXVIII: 966–985; XXIX: 986–1005; XXX: 1006–1024. - In a number of papers dealing with the lichen flora of selected areas recently visited by the author, the exsiccate numbers are stated in the lists of lichens (see the list of references at the end of the present paper).

Introduction

The 239 issued lichens are listed alphabetically together with some synonyms. Nomenclature follows Santesson et al. (2004) and Index Fungorum. Notes are given on the distribution of all taxa in Greenland. The known distribution of many species has changed since the publication of the index of fascicle I–X (Hansen 1995a), because of extensive collecting work in more northern parts of Greenland. At present the Greenland lichen flora consists of c. 1000 species.

List of lichens

Acarospora molybdina (Wahlenb.) Trevis. (Hansen 1995c) - W. Greenland, northwards to Upernavik; E. Greenland, with northern limit at Jørgen Brønlund Fjord: 647.
Alectoria nigricans (Ach.) Nyl. - All over Greenland: 151, 196, 323, 405, 431, 881, 1001, 1024.

- A. ochroleuca* (Hoffm.) A. Massal. - All over Greenland, but rare in N. Greenland: 18, 87, 256, 265, 298, 358, 408, 422, 506, 556, 813, 835, 878, 910, 918, 929, 1002.
- A. sarmentosa* subsp. *vexillifera* (Nyl.) D. Hawksw. (Syn. *A. vexillifera* (Nyl.) Stizenb.) - W. Greenland, northwards to Disko-Nuussuaq; rare in E. Greenland: 377, 498, 542, 651, 681, 948.
- Allantoparmelia alpicola* (Th. Fr.) Essl. (Syn. *Parmelia alpicola* Th. Fr.) - W. Greenland, northwards to Qaanaaq; E. Greenland, northwards to Traill Island: 141, 312, 636.
- Amygdalaria panaeola* (Ach.) Hertel & Brodo - W. Greenland; Central E. Greenland: 168.
- Arctocetraria andrejevii* (Oksner) Kärnefelt & A. Thell (Syn. *Cetraria andrejevii* Oksner, *C. simmonsii* Krog) (Kärnefelt 1979; Kärnefelt, Mattsson & A. Thell 1993) - W. Greenland, with northern limit at Upernavik; very rare in E. Greenland (Lindenows Fjord and Mesters Vig): 31, 142, 383, 397, 403, 425, 435, 473, 520, 628, 669, 688, 745, 836, 886, 891, 932, 962, 1009.
- A. nigricascens* (Nyl.) Kärnefelt & A. Thell (Syn. *Cetraria nigricascens* (Nyl.) Elenkin) (Hansen 1997) - N. and N.W. Greenland, southwards to Qasigiannuguit; rare in E. Greenland (Ittoqqortoormiit): 302, 356, 361, 464, 495, 791, 893.
- Arctoparmelia centrifuga* (L.) Hale (Syn. *Parmelia centrifuga* (L.) Ach.) W. Greenland, but rare north of Disko; scattered distribution in E. Greenland, northwards to Kong Oscars Fjord: 41, 375, 445, 471, 551, 989.
- A. incurva* (Pers.) Hale (Syn. *Parmelia incurva* (Pers.) Fr. (Hansen 2002) - W. Greenland, northwards to Inglefield Land: 178.
- A. separata* (Th. Fr.) Hale (Hansen 2000, 2002) - W. Greenland, Kangerlussuaq and different localities in Inglefield Land: 783.
- Arctopeltis thuleana* Poelt - The whole of W. Greenland: 478.
- Arthrorhaphis alpina* (Schaer.) R. Sant. (Hansen & Obermayer 1999) - All over Greenland: 844.
- A. citrinella* (Ach.) Poelt - All over Greenland: 342, 565, 981.
- Aspicilia candida* (Anzi) Hue (Syn. *A. nikrapensis* Darb., *Lecanora candida* (Anzi) Nyl.) (Esslinger & Egan 1995; Hansen 2001, 2002) - W. Greenland, northwards to Thule; N.E. Greenland, northwards to Romer Sø: 525, 777.
- Baeomyces placophyllus* Ach. - W. Greenland, northwards to Inglefield Land; E. Greenland, northwards to Romer Sø: 246.
- B. rufus* (Huds.) Rebent. - All over Greenland: 245.
- Bellemerea alpina* (Sommerf.) Clauzade & Cl. Roux (Syn. *Aspicilia alpina* (Sommerf.) Arnold) - W. Greenland, northwards to Disko-Nuussuaq; E. Greenland, northwards to Ittoqqortoormiit: 324.
- Biatora vernalis* (L.) Fr. (Syn. *Lecidea vernalis* (L.) Ach.) - All over Greenland: 212.
- Brodoa oroarctica* (Krog) Goward (Syn. *Hypogymnia oroarctica* Krog) - All over Greenland: 192, 953, 980, 998.
- Bryocaulon divergens* (Ach.) Kärnefelt (Syn. *Cornicularia divergens* Ach.) - All over Greenland, but rare in E. Greenland (Ittoqqortoormiit, Romer Sø): 125, 136, 140, 156, 209, 272, 328, 673, 707.

- Bryoria chalybeiformis* (L.) Brodo & D. Hawksw. (Syn. *Alectoria chalybeiformis* (L.) Gray) - All over Greenland, but most frequent in W. Greenland: 51, 118, 133, 307, 326, 415, 450, 518, 543, 593.
- B. lanestris* (Ach.) Brodo & D. Hawksw. - W. Greenland, northwards to Saqqaq: 890, 946.
- B. nitidula* (Th. Fr.) Brodo & D. Hawksw. (Syn. *Alectoria nitidula* (Th. Fr.) Vain.) - W. Greenland, northwards to Bonsall Øer, Inglefield Land: 20, 126, 194, 299, 357, 360, 367, 486, 522, 630, 880, 908, 919.
- Buellia elegans* Poelt (No. 596 has been distributed as "*Buellia epigaea* (Pers.) Tuck. v. *effigurata* (Schaer.) Zahlbr.") (Alstrup et al. 2000; Hansen 2001) - N. and N.E. Greenland: 756, 773.
- B. insignis* (Nägeli ex Hepp) Th. Fr. (Alstrup et al. 2000) - W. Greenland, northwards to Nuussuaq; E. Greenland, northwards to Bristol Plateau: 492.
- Caloplaca alcarum* Poelt (Hansen et al. 1987a) (Distributed as "10. *Caloplaca marina* Wedd.") - All over Greenland, northwards to Inglefield Land in W. Greenland and Jørgen Brønlund Fjord in E. Greenland: 10.
- C. castellana* (Räsänen) Poelt - All over Greenland: 641.
- C. decipiens* (Arnold) Blomb. & Forssell (Alstrup et al. 2000) - W. Greenland, northwards to Nuussuaq; E. Greenland, northwards to Campanuladal: 625.
- C. fraudans* (Th. Fr.) H. Olivier (Hansen et al. 1987a) - W. Greenland, northwards to Upernavik; E. Greenland, northwards to Romer Sø: 251, 633.
- C. jungermanniae* (Vahl) Th. Fr. - All over Greenland, but usually rather sparse on its habitats: 454, 901.
- C. tominii* L.I. Savicz (Hansen 2000) - Rare in both W. Greenland (Søndre Strømfjord, Disko-Nuussuaq, Inglefield Land) and E. Greenland (Kronprins Christian Land, Peary Land): 338, 455, 610, 722, 734.
- Calvitimela aglaea* (Sommerf.) Hafellner (Syn. *Tephromela aglaea* (Sommerf.) Hertel & Rambold) - W. Greenland, northern limit at Upernavik; C.E. and N.E. Greenland: . 2, 555.
- C. armeniaca* (DC.) Hafellner (Syn. *Tephromela armeniaca* (DC.) Hertel & Rambold) - All over Greenland: 150.
- Candelariella arctica* (Körb.) R. Sant. (Syn. *C. crenulata* (Wahlenb.) Zahlbr.) - W. Greenland, northwards to Disko-Nuussuaq: 248.
- C. placodizans* (Nyl.) H. Magn. - All over Greenland: 6, 161, 268, 309, 344, 427, 483, 535, 559, 786, 802, 825, 896.
- Catapyrenium lachneum* (Ach.) R. Sant. (Syn. *Dermatocarpon rufescens* (Ach.) Th. Fr.) (Breuss & Hansen 1988) - All over Greenland: 108, 648, 897.
- Cephalophysis leucospila* (Anzi) H. Kiliass & Scheid. (Syn. *Lecidea ultima* Th. Fr.) (Hansen 2001) - N. and N.E. Greenland: 420.
- Cetraria islandica* (L.) Ach. - All over Greenland: 36, 53, 316, 359, 547, 691, 739, 840, 849, 883, 914, 963, 974, 977, 1021.
- C. muricata* (Ach.) Eckfeldt (Syn. *Coelocaulon muricatum* (Ach.) J.R. Laundon) - All over Greenland: 67, 857.
- C. nigricans* Nyl. - W. Greenland, with northern limit at Qaanaaq: 5, 91, 113, 255, 277, 395, 490, 885, 940.
- C. sepincola* (Ehrh.) Ach. - S.W. and S.E. Greenland; northern limit at c.66°N: 17, 271.

- Cetrariella delisei* (Bory ex Schaer.) Kärnefelt & A. Thell (Syn. *Cetraria delisei* (Bory ex Schaer.) Nyl.) (Kärnefelt, Mattsson & A. Thell 1993) - All over Greenland: 34, 55, 158, 197, 301, 319, 368, 378, 434, 449, 567, 581, 615, 689, 744, 812, 821, 841, 856, 882, 915, 959, 992, 1004.
- Chaenotheca furfuracea* (L.) Tibell (Syn. *Coniocybe furfuracea* (L.) Ach.) - All over Greenland except the northernmost areas: 242.
- Cladonia acuminata* (Ach.) Norrl. - W. Greenland, with northern limit at Prøven; Central E. Greenland: 138.
- C. alaskana* A. Evans (Hansen 1995b, 2002) - C.W. and N.W. Greenland: 785.
- C. amaurocraea* (Flörke) Schaer. - All over Greenland apart from N.E. Greenland north of Zackenberg: 54, 128, 132, 406, 697, 866.
- C. arbuscula* (Wallr.) Flot. subsp. *arbuscula* (Thomson 1984) - S.W. Greenland: 32, 210.
- C. arbuscula* subsp. *mitis* (Sandst.) Ruoss - All over Greenland apart from N. and N.E. Greenland: 27, 88, 381, 437, 568, 677, 711, 843, 855, 887, 913, 966, 984, 1022.
- C. bellidiflora* (Ach.) Schaer. - W. Greenland, with northern limit at Qaanaq; S.E. Greenland, northwards to Tasiilaq: 25, 164, 182, 376, 436, 447, 709, 917, 947, 987.
- C. borealis* S. Stenroos - All over Greenland apart from N. Greenland: 204, 538, 741, 858, 965.
- C. cariosa* (Ach.) Spreng. - All over Greenland apart from the northernmost areas: 104, 139, 262.
- C. carneola* (Fr.) Fr. - W. Greenland, northwards to Disko; S.E. Greenland, northwards to Tugtilik: 44, 703.
- C. cenotea* (Ach.) Schaer. (Hansen 1995b) - All over Greenland except N.E. Greenland: 634.
- C. cornuta* (L.) Hoffm. - All over Greenland except N. Greenland: 393, 654.
- C. crispata* (Ach.) Flot. - W. Greenland, northwards to Disko; S.E. Greenland, northwards to Tugtilik: 227, 233, 390, 655, 696, 710.
- C. cyanipes* (Sommerf.) Nyl. (Hansen 2002) - W. Greenland, northwards to Inglefield Land; E. Greenland, northwards to Kejser Franz Joseph Fjord: 111, 394, 517, 638.
- C. ecmocyna* Leight. - All over Greenland except the northernmost areas: 37, 114, 120, 369, 423, 540, 656, 701, 747, 870, 945, 976.
- C. fimbriata* (L.) Fr. s.lat. - W. Greenland, with northern limit at Qaanaq; E. Greenland, northwards to Traill Island: 278, 871.
- C. gracilis* (L.) Willd. (No. 216 = *C. gracilis* subsp. *nigripes* (Nyl.) Ahti) - All over Greenland except its northernmost parts: 216.
- C. macroceras* (Delise) Ahti - All over Greenland except the northernmost areas: 68, 231, 501.
- C. macrophylla* (Schaer.) Stenh. (Syn. *C. alpicola* (Flot.) Vain.) - All over Greenland except N. and N.W. Greenland: 30, 179, 234, 629.
- C. macrophyllodes* Nyl. (No. 409 has been distributed as "*Cladonia cervicornis* (Ach.) Flot.") (Hansen 2005) - W. Greenland, northwards to Uummannaq; E. Greenland, northwards to Lamberts Land: 174, 409, 441, 614, 683, 850, 978.

- C. phyllophora* Hoffm. (Hansen 1995b, 2005) (Syn. *C. degenerans* (Flörke) Spreng.) W. Greenland, northwards to Uummannaq; E. Greenland, northwards to Ittoqqortoortoomiut: 274, 639, 983.
- C. pleurota* (Flörke) Schaer. - All over Greenland except N. and N.E. Greenland: 26, 72.
- C. pocillum* (Ach.) O.J. Rich. - All over Greenland, even in Peary Land: 199, 346, 578, 606, 617, 719, 769, 775, 819.
- C. pyxidata* (L.) Hoffm. - All over Greenland: 63, 458, 554, 667, 941.
- C. rangiferina* (L.) F.H. Wigg. W. Greenland; E. Greenland (Revision of Greenland material of *Cladonia rangiferina* and *C. stygia* needed): 89.
- C. squamosa* Hoffm. (Hansen 2002) - W. Greenland, northwards to Inglefield Land; E. Greenland, northwards to Kejser Franz Joseph Fjord: 65.
- C. stellaris* (Opiz) Pouzar & Vězda - W. Greenland, northwards to Qeqertaq (Nuussuaq): 35, 56, 99, 135, 387, 407, 430, 442, 474, 505, 511, 521, 529, 652, 692, 837, 921, 961.
- C. stellata* (Nyl.) Nyl. (Syn. *C. lepidota* auct.) - All over Greenland except N. and N.E. Greenland north of c.75°N: 92, 236, 273, 279, 467.
- C. stygia* (Fr.) Ruoss - W. Greenland; S.E. Greenland: 29, 162, 386, 428, 446, 653, 694, 838, 851, 876, 928, 934, 968, 1013.
- C. sulphurina* (Michx.) Fr. (Syn. *C. gonecha* (Ach.) Asah.) - W. Greenland, northwards to Qaanaaq; E. Greenland, northwards to Ittoqqortoormiit: 50, 71, 84, 373, 742, 933.
- C. trassii* Ahti (No. 92, 236, 273, 279, 467, all identified as *C. stricta* (Nyl.) Nyl., belong to this taxon): 658, 746, 875, 944.
- C. turgida* Hoffm. - S.W. Greenland, northwards to c. 66°N: 533.
- C. uncialis* (L.) F.H. Wigg. - W. Greenland, northwards to Disko-Nuussuaq: E. Greenland, northwards to c.73°N: 28, 380, 451, 534, 690, 743, 1005.
- Collema coccophorum* Tuck. (Alstrup et al. 2000) - N.E. Greenland, Kronprins Christian Land: 624.
- C. substellatum* H. Magn. (Alstrup et al. 2000; Hansen 2001, 2002) - N., N.W. and N.E. Greenland, southwards to 79°N: 599, 758.
- Dacampia hookeri* (Borrer) A. Massal. - All over Greenland apart from S.E. Greenland: 751, 799.
- Dactylina arctica* (Hook. f.) Nyl. - All over W. Greenland, but rare towards the south: 100, 112, 122, 306, 488, 805, 820, 930.
- D. ramulosa* (Hook. f.) Tuck. - N. and N.W. Greenland, southwards to Disko; scattered in N.E. Greenland: 94, 116, 123, 289, 592, 806, 817, 909.
- Dermatocarpon miniatum* (L.) W. Mann - All over Greenland except N.W. Greenland: 259.
- D. rivulorum* (Arnold) Dalla Torre & Sarnth. - W. Greenland, northwards to Disko; E. Greenland, northwards to Ittoqqortoormiit: 252.
- Dibaeis baeomyces* (L. f.) Rambold & Hertel (Syn. *Baeomyces roseus* Pers.) - All over Greenland: 244.
- Dimelaena oreina* (Ach.) Norman - All over Greenland, but rare in S.E. Greenland: 726, 767.
- Diploschistes muscorum* (Scop.) R. Sant. - All over Greenland except S.E.

- Greenland: 573, 597, 724.
- Endocarpon pulvinatum* Th. Fr. - All over Greenland, but rare in E. Greenland: 640.
- Ephebe hispidula* (Ach.) Horw. - W. Greenland, northwards to Disko; E. Greenland (Tasiilaq, Kronprins Christian Land): 675, 973.
- E. lanata* (L.) Vain. - W. Greenland, northwards to Disko; scattered distributed in E. Greenland (Tasiilaq, Ittoqqortoormiit, Kong Oscars Fjord): 189, 379.
- Epilichen scabrosus* (Ach.) Clem. (Hansen 2002) - W. Greenland, northwards to Upernavik; E. Greenland (Sermilik, Zackenberg, Kronprins Christian Land): 637.
- Farnoldia jurana* (Schaer.) Hertel - S.W. Greenland: 503.
- Flavocetraria cucullata* (Bellardi) Kärnefelt & A. Thell - All over Greenland: 16, 297, 317, 469, 508, 572, 822, 877, 907, 1008.
- F. nivalis* (L.) Kärnefelt & A. Thell - All over Greenland; extremely widespread: 15, 57, 159, 303, 318, 424, 468, 687, 814, 842, 867, 879, 906, 920, 958, 1003.
- Fulgensia bracteata* (Hoffm.) Räsänen - All over Greenland except S.W. and S.E. Greenland: 336, 577, 619, 754, 762.
- Glypholecia scabra* (Pers.) Müll. Arg. (Alstrup et al. 2000) - W. Greenland northwards to Maarmorilik; N.E. Greenland (Kronprins Christian Land, Peary Land): 595.
- Gyalecta friesii* (A. Massal.) Körb. (Hansen et al. 1987b) - W. Greenland, northwards to Disko: 239.
- Hypogymnia austerodes* (Nyl.) Räsänen - All over Greenland, but comparatively rare in E. Greenland: 11, 203, 413.
- H. physodes* (L.) Nyl. - W. Greenland, northwards to Inglefield Land; very rare in E. Greenland (Ittoqqortoormiit): 7, 258, 527, 999.
- H. subobscura* (Vain.) Poelt - All over Greenland: 784, 800.
- Icmadophila ericetorum* (L.) Zahlbr. - S.W. and S.E. Greenland: 253, 461, 662, 834.
- Illosporium carneum* Fr. - All over N. Greenland; more rare in E. Greenland: 643.
- Ionaspis odora* (Ach.) Th. Fr. (Syn. *I. suaveolens* (Schaer.) Th. Fr.) - S.W., N.W. and N.E. Greenland: 465, 580.
- Lasallia pennsylvanica* (Hoffm.) Llano (Syn. *Umbilicaria pennsylvanica* Hoffm.) - S.W. Greenland, northwards to Sisimiut . 232, 281, 668.
- Lecanora argopholis* (Ach.) Ach. - All over Greenland: 645, 852.
- L. circumborealis* Brodo & Vitik. (Syn. *L. coilocarpa* auct.) - S.W. Greenland: 276.
- L. epibryon* (Ach.) Ach. - All over Greenland . 217, 332, 462, 755.
- L. geophila* (Th. Fr.) Poelt (Syn. *L. pachythallina* Lynge) - All over Greenland apart from S.E. Greenland: 345, 571.
- L. leptacina* Sommerf. - W. Greenland, northwards to Disko; very rare in E. Greenland (Tasiilaq, Mikis Fjord, Ittoqqortoormiit): 186.
- L. luteovernalis* Brodo - C.W., N.W. and N.E. Greenland: 616, 796.
- L. marginata* (Schaer.) Hertel & Rambold (Syn. *Lecidea marginata* Schaer., *Lecidea elata* Schaer.; *Lecanora atromarginata* (H. Magn.) Hertel & Rambold possibly also belong to this taxon) (Thomson 1997) - All over Greenland: 339, 584, 626.

- L. muralis* (Schreb.) Rabenh. - S.W., W. and N.E. Greenland: 22.
- L. polytropa* (Hoffm.) Rabenh. - All over Greenland: 42, 190, 269, 586.
- L. rupicola* subsp. *arctoa* Leuckert & Poelt - Central W. Greenland (Disko): 167.
- L. straminea* Wahlenb. ex Ach. - W. Greenland, northwards to Nuussuaq; S.E. Greenland: 1, 60, 250.
- L. swartzii* (Ach.) Ach. (Syn. *L. subradiosa* Nyl.) - S.W. Greenland, northwards to Disko; N.E. Greenland: 145.
- Lecideia atrobrunnea* (Ramond ex Lam. & DC.) Schaer. - All over Greenland: 770.
- L. ramulosa* Th. Fr. - All over Greenland except S.E. Greenland: 765, 780, 797.
- L. tessellata* Flörke - All over Greenland: 794.
- Lecidella bullata* Körb. (Alstrup et al. 2000, Hansen 2001, 2002) - C.W., N.W., N. and N.E. Greenland: 621.
- Lempholemma polyanthes* (Bernh.) Malme (Syn. *L. myriococcum* (Ach.) Th. Fr.) - W. Greenland, northwards to Thule: 176.
- Lepraria frigida* J.R. Laundon. - Widely distributed in both W. and E. Greenland: 816, 931, 971.
- L. neglecta* (Nyl.) Erichsen (Syn. *Crocynia neglecta* (Nyl.) Hue) - All over Greenland: 83, 320.
- Leprocaulon subalbicans* (I.M. Lamb) I.M. Lamb & A.M. Ward - Widely distributed in both W. and E. Greenland: 219, 411, 544, 927, 938.
- Leptoloma vouauxii* (Hue) J.R. Laundon (Syn. *Lepraria arctica* (Lynge) Wetmore) - All over Greenland except N.W. Greenland: 348, 598, 757.
- Leptochidium albociliatum* (Desm.) M. Choisy (Syn. *Polychidium albociliatum* (Desm.) Zahlbr.) - Central W. Greenland Disko: 175.
- Leptogium lichenoides* (L.) Zahlbr. (Hansen 2000) - All over Greenland: 795.
- L. saturninum* (Dicks.) Nyl. - W. Greenland, northwards to Maarmorilik; rare in E. Greenland (Tasiilaq, Tågefjord): 115, 214, 729.
- Lichenomphalia hudsoniana* (H.S. Jenn.) Redhead et al. (Syn. *Omphalina hudsoniana* (H.S. Jenn.) H.E. Bigelow, *Coriscium viride* (Ach.) Vain.) - All over Greenland; rare in E. Greenland (Isertoq near Tasiilaq): 452, 485, 537.
- Lobaria scrobiculata* (Scop.) P. Gaertn. - S.W. Greenland, northwards to Qasigianniguit: 137, 224.
- Massalongia carnosa* (Dicks.) Körb. - W. Greenland, with northern limit at Upernavik; rare in E. Greenland (Tasiilaq, Ittoqqortoormiit): 220, 487, 523, 665, 699.
- Melanelia commixta* (Nyl.) A. Thell (Syn. *Cetraria commixta* (Nyl.) Th. Fr.) - W. Greenland, northwards to Disko; S.E. Greenland; very rare in N.E. Greenland: 497.
- M. hepatizon* (Ach.) A. Thell (Syn. *Cetraria hepatizon* (Ach.) Vain.) - All over Greenland, but very rare in the northernmost areas: 193, 350, 546, 993.
- M. infumata* (Nyl.) Essl. (Syn. *Parmelia infumata* Nyl.) All over Greenland, even the high arctic areas: 77, 177, 607, 764, 905.
- M. septentrionalis* (Lynge) Essl. (Syn. *Parmelia septentrionalis* (Lynge) Ahti) - W. Greenland, northwards to Qaumarujuk at Maarmorilik: 180, 275, 660.
- M. tominii* (Oksner) Essl. - All over W. Greenland; N.E. Greenland: 604.
- Micarea assimilata* (Nyl.) Coppins (Syn. *Lecideia assimilata* Nyl.) All over Greenland: 172, 247, 401.

- Miriquidica atrofulva* (Sommerf.) A.J. Schwab & Rambold (Syn. *Lecidea atrofulva* Sommerf.) - W. Greenland, northwards to Upernavik; more rare or neglected in E. Greenland (Tasiilaq): 426.
- M. leucophaea* (Flörke ex Rabenh.) Hertel & Rambold (Syn. *Lecidea leucophaea* (Flörke ex Rabenh.) Th. Fr.) - W. Greenland, northwards to Nuussuaq; all over E. Greenland: 185.
- Mycoblastus alpinus* (Fr.) Th. Fr. ex Hellb. - W. Greenland, northwards to Disko; S.E. Greenland (Tasiilaq): 706.
- Myxobilimbia lobulata* (Sommerf.) Hafellner. - All over Greenland: 766, 861, 997.
- Nephroma arcticum* (L.) Torss. - W. Greenland, northwards to Nuussuaq; rare in S.E. Greenland (Qaartuluk, Tasiilaq): 33, 86, 181, 183, 370, 388, 472, 514, 532, 664, 700, 748, 830, 832, 922, 967.
- N. bellum* (Spreng.) Tuck. - S.W. Greenland, northwards to Sisimiut; very rare in S.E. Greenland (Skjoldungen): 661.
- N. expallidum* (Nyl.) Nyl. - W. Greenland, northwards to Prøven (c.72°N); rare in E. Greenland (Kong Oscars Fjord): 98, 282, 416, 489, 731.
- N. parile* (Ach.) Ach. - W. Greenland, northwards to Svartenhuk Peninsula; S.E. Greenland, northwards to Tugtilik: 109, 235, 280, 684, 1018.
- Ochrolechia frigida* (Sw.) Lyngé (including *O. lapuënsis* (Vain.) Räsänen) - All over Greenland: 24, 412, 833, 846, 900, 964.
- O. grimmiae* Lyngé - All over Greenland; rare in E. Greenland (Tasiilaq, Tugtilik): 46, 163, 698.
- O. tartarea* (L.) A. Massal. - S.W. Greenland; rare in S.E. Greenland: 500, 1017.
- U. upsaliensis* (L.) A. Massal. - All over Greenland: 732.
- Ophioparma ventosa* (L.) Norman (Syn. *Haematomma ventosum* (L.) A. Massal.) - All over Greenland except the northernmost areas: 631.
- Orphniospora moriopsis* (A. Massal.) D. Hawksw. (Syn. *Buellia atrata* (Sm.) Anzi) - All over Greenland: 146, 372, 460, 889, 1023.
- Parmelia fraudans* (Nyl.) Nyl. - W. Greenland, northwards to Disko: 121.
- P. omphalodes* (L.) Ach. - All over Greenland, but rare in N. and N.E. Greenland: 804.
- P. saxatilis* (L.) Ach. - All over Greenland, but rare in N. and N.E. Greenland: 19, 195, 385, 484, 847, 954, 986.
- P. sulcata* Taylor - All over Greenland except N. and N.E. Greenland: 12, 672, 952, 1000.
- Parmeliopsis ambigua* (Wulfen) Nyl. - W. Greenland, northwards to Qasigiannugit; rare in E. Greenland (Tasiilaq, the inner part of Scoresby Sund): 223, 396.
- P. hyperopta* (Ach.) Arnold - S.W. Greenland; rare in S.E. Greenland (Skjoldungen): 257.
- Peltigera aphthosa* (L.) Willd. - All over Greenland, but rare to the north (the Greenland material of *Peltigera* is at present under revision): 13, 81, 392, 429, 569, 659, 725, 937, 1020.
- P. canina* (L.) Willd. - All over Greenland except N. and N.E. Greenland: 62, 73, 513, 545, 730.

- P. collina* (Ach.) Röhl. (Syn. *P. scutata* (Dicks.) Duby) - W. Greenland, northwards to Disko: 493.
- P. didactyla* (With.) J.R. Laundon (Syn. *P. spuria* (Ach.) DC.) - All over Greenland: 74, 399, 643, 892.
- P. kristinssonii* Vitik. - W. and E. Greenland, but rare to the north: 682.
- P. leucophlebia* (Nyl.) Gyeln. - All over Greenland, but rare to the north: 198, 453, 470, 516, 594, 736, 801, 808, 936.
- P. malacea* (Ach.) Funck - All over Greenland except N. and N.E. Greenland north of 75°N: 52, 865.
- P. polydactylon* (Neck.) Hoffm. - W. and E. Greenland, but lacking in the northernmost areas: 960.
- P. rufescens* (Weiss) Humb. - All over Greenland. The species is the only *Peltigera* occurring in the extreme high arctic part of Greenland (Vitikainen 1994): 335, 566, 712, 750, 772.
- P. scabrosa* Th. Fr. - W. Greenland, northwards to Siorapaluk; S.E. Greenland: 391, 475, 548.
- P. venosa* (L.) Baumg. - All over Greenland except N. Greenland: 206, 418.
- Pertusaria coriacea* (Th. Fr.) Th. Fr. - All over Greenland: 201, 539, 557.
- P. dactylina* (Ach.) Nyl. - All over Greenland except N. Greenland: 205, 457.
- P. oculata* (Dicks.) Th. Fr. - All over Greenland except N. Greenland: 261, 398, 448, 476, 686, 749, 869.
- Phaeocalicium compressulum* (Nyl. ex Vain.) A.F.W. Schmidt - S.W. Greenland, northwards to c. 66°N: 222.
- Phaeophyscia constipata* (Norrl. & Nyl.) Moberg. - W. Greenland, northwards to Maarmorilik; N.E. Greenland: 716.
- P. sciastra* (Ach.) Moberg - All over Greenland: 926.
- Physcia caesia* (Hoffm.) Fűrnr. (Moberg & Hansen 1986) - All over Greenland, even the extreme high arctic areas: 243, 579, 718, 982.
- P. dubia* (Hoffm.) Lettau - All over Greenland: 635, 671, 717, 782, 873.
- P. tenella* (Scop.) DC. - W. Greenland, northwards to Ummannaq; rare in S.E. Greenland (Tasiilaq): 649.
- Physconia detera* (Nyl.) Poelt - W. Greenland, northwards to Disko-Nuussuaq: 144.
- P. muscigena* (Ach.) Poelt (Moberg & Hansen 1986) - All over Greenland, even the high arctic areas: 78, 211, 331, 340, 477, 720, 763, 779, 807.
- Pilophorus dovrensis* (Nyl.) Timdal, Hertel & Rambold (Syn. *Lecidea pallida* Th. Fr.) - W. Greenland, northwards to Disko; E. Greenland, northwards to Kong Oscars Fjord: 169, 249.
- Placopsis gelida* (L.) Linds. - All over Greenland except its northernmost parts: 207.
- Placynthium asperellum* (Ach.) Trevis. - All over Greenland: 642, 899.
- P. subradiatum* (Nyl.) Arnold (Alstrup et al. 2000) - Rare in N.E. Greenland: 620.
- Platismatia glauca* (L.) W.L. Culb. & C.F. Culb. - S.W. Greenland, northwards to Nuuk: 254, 496, 693.

- Polychidium muscicola* (Sw.) Gray (Hansen 2002, 2005) - W. Greenland, northwards to Umannaq; all over E. Greenland except its northernmost parts: 674.
- Porpidia flavocaerulescens* (Hornem.) Hertel & A.J. Schwab - All over W. Greenland; S.E. Greenland: 969.
- P. macrocarpa* (DC.) Hertel & A.J. Schwab - All over Greenland except its northernmost parts: 165.
- P. melinodes* (Körb.) Gowan & Ahti - All over Greenland: 291, 351, 371, 550, 670.
- Protoblastenia calva* (Dicks.) Zahlbr. - All over W. Greenland; N.E. Greenland: 622.
- P. rupestris* (Scop.) J. Steiner - All over Greenland except N.W. Greenland: 352.
- P. terricola* (Anzi) Lynge - All over Greenland except S.W. and S.E. Greenland: 774.
- Protoparmelia badia* (Hoffm.) Hafellner - All over Greenland except N. Greenland: 644.
- Pseudephebe minuscula* (Nyl. ex Arnold) Brodo & D. Hawksw. (Syn. *Alectoria minuscula* (Nyl. ex Arnold) Degel.) - All over Greenland: 296, 321, 365, 432, 564, 587, 789, 809, 828, 848, 853, 912.
- P. pubescens* (L.) M. Choisy (Syn. *Alectoria pubescens* (L.) R. Howe) - All over Greenland, but rare in N. Greenland: 40, 148, 215, 404, 541, 676, 1016.
- Psora decipiens* (Hedw.) Hoffm. - All over Greenland: 583, 771.
- P. rubiformis* (Ach.) Hook. (Syn. *Lecidea rubiformis* (Ach.) Wahlenb.) - All over Greenland: 79, 107, 147, 310, 343, 558, 609, 618, 714, 787.
- P. vallesiaca* (Schaer.) Timdal (Syn. *P. albilabra* (Dufour) Körb.) - S.W., N.W. and N.E. Greenland: 337.
- Psoroma hypnorum* (Vahl) Gray - All over Greenland, but rare in more northern parts of Greenland, where the species often is replaced by *Psoroma tenue* Henssen: 23, 226, 845, 955, 988.
- Psorula rufonigra* (Tuck.) Gotth. Schneid. (Syn. *Lecidea rufonigra* (Tuck.) Nyl.) - S.W. Greenland (Narssarsuaq; Kangerlussuaq): 456.
- Rhagadostoma lichenicola* (De Not.) Keissl. - All over Greenland except N. and N.E. Greenland (vide *Solorina crocea*): 602, 685, 859.
- Rhizocarpon atroflavescens* Lynge - N.E. Greenland (Peary Land, Kronprins Christian Land): 334.
- R. bolanderi* (Tuck.) Herre - W. Greenland, northwards to Upernavik: 124.
- R. geminatum* Körb. (Syn. *R. disporum* auct. non (Nägeli ex Hepp) Müll. Arg.) - All over Greenland: 238, 419, 504, 776, 902.
- R. geographicum* (L.) DC. - All over Greenland: 58, 184, 191, 327, 362, 650, 733, 950.
- R. grande* (Flörke) Arnold (Hansen 2001) - All over Greenland except N. Greenland: 61.
- R. inarense* (Vain.) Vain. - All over W. Greenland; more rare in E. Greenland (the fjords around Tasiilaq; Ittoqqortoormiit, Romer Sø): 438.
- R. praebadium* (Nyl.) Zahlbr. - All over Greenland: 613.
- R. pusillum* Runemark - Central and northernmost parts of Greenland: 295, (333), 760.

- R. superficialis* subsp. *boreale* Runemark (Syn. *R. crystalligenum* Lynge) - All over Greenland: 3, 382, 605.
- Rhizoplaca chrysoleuca* (Sm.) Zopf (Syn. *Lecanora rubina* (Vill.) Ach.) - W. Greenland, northwards to Maarmorilik: 80, 130, 715.
- R. melanophthalma* (DC.) Leuckert & Poelt (Syn. *Lecanora melanophthalma* (DC.) Ramond) - All over Greenland: 76, 363, 491, 560, 582, 611, 727.
- Santessoniella arctophila* (Th. Fr.) Henssen (Syn. *Parmeliella arctophila* (Th. Fr.) Malme) - Disko: 153.
- Solorina bispora* Nyl. - All over Greenland: 202, 417.
- S. crocea* (L.) Ach. - All over Greenland except N. and N.E. Greenland north of 75°N: 39, 85, 322, 439, 524, 602, 663, 685, 831, 859, 975.
- S. octospora* Arnold - W. Greenland, northwards to Disko; between 71°N and 75°N in E. Greenland: 97, 646.
- S. saccata* (L.) Ach. (Hansen 2001, 2002) - All over Greenland except S.E. Greenland: 479.
- Sphaerellothecium cladoniicola* E.S. Hansen & Alstrup (Hansen & Alstrup 1995) - All over Greenland except N. and N.E. Greenland north of c. 70°N: 552, 851.
- Sphaerophorus fragilis* (L.) Pers. - W. Greenland, northwards to Thule; E. Greenland, northwards to Lambert Land: 45, 59, 263, 313, 364, 384, 868, 898, 956.
- S. globosus* (Huds.) Vain. - All over W. Greenland; E. Greenland, northwards to Lambert Land: 38, 64, 166, 293, 536, 704, 738, 957, 979, 874, 1007.
- Sporastatia polyspora* (Nyl.) Grummann (Syn. *S. cinerea* (Schaer.) Körb.) - All over Greenland: 157, 480.
- S. testudinea* (Ach.) A. Massal. - All over Greenland: 149, 294, 333, 347, 563, 589, 759.
- Stereocaulon alpinum* Laurer - All over Greenland, but rare in N. and N.E. Greenland north of 75°N: 8, 170, 187, 349, 421, 510, 531, 601, 705, 737, 829, 854, 888, 916, 996, 1012, 1019.
- S. arcticum* Lynge (Distributed as “49. *Stereocaulon vesuvianum* Pers”) (Lamb 1977, Hansen 2005) - W. Greenland, northwards to Uummannaq: 49, 292, 355, 528, 860.
- S. arenarium* (L.I. Savicz) I.M. Lamb - All over Greenland: 213, 400, 811, 991.
- S. botryosum* Ach. - All over Greenland; common in W. Greenland, but more sparsely distributed in E. Greenland: 208, 440, 632, 792.
- S. condensatum* Hoffm. - All over Greenland except S.E. Greenland: 173, 481, 728, 923.
- S. cumulatum* (Sommerf.) Timdal (Syn. *Toninia cumulata* (Sommerf.) Th. Fr.) - All over Greenland : 482.
- S. glareosum* (L.I. Savicz) H. Magn. (Hansen 2002) - All over Greenland apart from the northernmost part of E. Greenland: 129, 154, 241, 526, 574, 815, 864, 985.
- S. paschale* (L.) Hoffm. - W. Greenland, northwards to Disko; E. Greenland, northwards to Kong Oscars Fjord: 69, 228, 237, 389, 443, 512, 530, 657, 695, 735, 839, 935.

- S. rivulorum* H. Magn. - All over Greenland: 341, 499, 588.
- S. tomentosum* Fr. - W. Greenland, northwards to Disko: 218.
- S. vesuvianum* Pers. - All over Greenland except N. and N.E. Greenland: 70, 134, 678.
- Thamnolia vermicularis* (Sw.) Schaer. (including *T. subuliformis* (Ehrh.) W.L. Culb.) - All over Greenland: 101, 509, 570, 612, 781, 911, 995, 1006, 1015.
- Toninia arctica* Timdal (Timdal 1991) - All over Greenland except S.W. and S.E. Greenland: 585, 623, 761, 798.
- T. sedifolia* (Scop.) Timdal (Syn. *T. caeruleonigricans* (Lightf.) Th. Fr.) (Timdal 1991) - All over Greenland, but rare in S.E. Greenland: 110, 260, 329.
- Trapeliopsis granulosa* (Hoffm.) Lumbsch. (Syn. *Lecidea granulosa* (Hoffm.) Ach.) - W. Greenland, northwards to Qaanaaq; rare in S.E. Greenland: 225, 627, 666, 740.
- Tremolecia atrata* (Ach.) Hertel (Syn. *Lecidea Dicksonii* auct.) - All over Greenland: 43, 290, 311, 803.
- Umbilicaria arctica* (Ach.) Nyl. - All over Greenland, but rare in the extreme high arctic areas: 47, 131, 200, 374, 872, 894, 943, 949, 990, 1011.
- U. cinereorufescens* (Schaer.) Frey - S.W. Greenland, northwards to Disko: 127, 549.
- U. cylindrica* (L.) Delise ex Duby (Some collections, for example, No. 105 and 285, come very close to *Umbilicaria virginis* Schaer.) - All over Greenland: 66, 82, 105, 285, 433, 603, 951.
- U. decussata* (Vill.) Zahlbr. (Syn. *Omphalodiscus decussatus* (Vill.) Schol.) - All over Greenland: 103, 354, 810, 904.
- U. deusta* (L.) Baumg. - W. Greenland, northwards to Qaanaaq; E. Greenland, northwards to Kong Oscars Fjord: 106, 119, 553, 970.
- U. havaasii* Llano - W. Greenland, northwards to Disko-Nuussuaq: 4, 270, 414, 679.
- U. hyperborea* (Ach.) Hoffm. - All over Greenland, but rare in the northernmost areas: 95, 519, 590, 707, 863, 994.
- U. lyngei* Schol. (Syn. *Agyrophora lyngei* (Schol.) Llano - All over Greenland: 9, 96, 143, 264, 304, 507, 576, 713, 790, 823, 827, 884.
- U. nylanderiana* (Zahlbr.) H. Magn. (Hansen 2002, 2004) - C.W. and N.W. Greenland: 1010.
- U. polyphylla* (L.) Baumg. - W. Greenland, northwards to Disko; S.E. Greenland: 680.
- U. proboscidea* (L.) Schrad. - All over Greenland: 90, 266, 283, 288, 300, 314.
- U. rigida* (Du Rietz) Frey (Syn. *Agyrophora rigida* (Du Rietz) Llano) - All over Greenland, but rare in E. Greenland: 402.
- U. torrefacta* (Lightf.) Schrad. (Hansen 2001) - All over Greenland: 160, 240, 267, 410, 444.
- U. vellea* (L.) Hoffm. - All over Greenland except N. and N.E. Greenland: 14, 229, 353, 494, 515, 939.
- U. virginis* Schaer. (Syn. *Omphalodiscus virginis* (Schaer.) Schol.) - All over Greenland: 188, 286, 308, 315, 818, 862, 895, 942, 972.
- Usnea sphacelata* R. Br. (Syn. *Neuropogon sulphureus* (J. König) Elenkin) - All over Greenland, at higher elevations in S. Greenland. Max. altitude c. 1700 m a.s.l.: 102, 152, 284, 287, 325, 466, 562, 591.

- Varicellaria rhodocarpa* (Körb.) Th. Fr. - S.W. Greenland, northwards to c.66°N: 221.
- Verrucaria mucosa* Wahlenb. - W. Greenland, northwards to Disko; S.E. Greenland: 117.
- V. thalassina* (Zahlbr.) Zschacke - S.W. and C.E. Greenland, very rare: 502.
- Vulpicida pinastri* (Scop.) J.-E. Mattsson & M.-J. Lai (Syn. *Cetraria pinastri* (Scop.) Gray) (Mattsson 1993) - S.W. Greenland, northwards to c. 66°N: 230.
- V. tilesii* (Ach.) J.-E. Mattsson & M.-J. Lai (Syn. *Cetraria tilesii* Ach.) - N., N.W. and N.E. Greenland: 463.
- Xanthoria borealis* R. Sant. & Poelt - All over Greenland, even the extreme high arctic areas: 48, 75, 366, 708, 824.
- X. elegans* (Link) Th. Fr. - All over Greenland, one of the most common epilithic lichens even in the high arctic areas: 21, 93, 155, 305, 330, 561, 575, 723, 725, 768, 778, 826, 903.
- X. elegans* var *splendens* (Darb.) M.S. Christ. ex Poelt (Alstrup et al. 2000, Hansen 2001, 2002) - N.W., N.E. and N. Greenland: 608, 793.
- X. fulva* (Hoffm.) Poelt & Petut. (Hansen 2003) - C.W. Greenland (Kangerlussuaq): 925.
- X. soreliata* (Vain.) Poelt - All over Greenland, but usually less frequent and in smaller quantities at its localities than *Xanthoria elegans*: 459, 600.

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Index of Lichenes Danici Exsiccati fascicles I–XX with notes on distribution of the taxa in Denmark

ERIC STEEN HANSEN

erich@snm.ku.dk

Botanical Museum

Natural History Museum of Denmark, University of Copenhagen

Gothersgade 130, DK-1123 Copenhagen K, Denmark

Abstract - The present list of lichens (and a few lichenicolous fungi) contains 161 lichen taxa, which have been distributed from the Botanical Museum, University of Copenhagen, in the period 1995 to 2006. The series, “Lichenes Danici Exsiccati”, comprises 20 fascicles in all and includes lichen collections from most parts of Denmark. The exsiccate has from the beginning been edited and arranged by the author of this paper. The 20 fascicles comprise the following numbers: I: 1–25; II: 26–50; III: 51–75; IV: 76–100; V: 101–125; VI: 126–150; VII: 151–175; VIII: 176–200; IX: 201–225; X: 226–250; XI: 251–275; XII: 276–300; XIII: 301–325; XIV: 326–350; XV: 351–375; XVI: 376–400; XVII: 401–425; XVIII: 426–450; XIX: 451–475; XX: 476–505. Notes on the current frequency and distribution of all Danish taxa are also provided.

Introduction

The 161 issued lichens are listed alphabetically together with some synonyms. Nomenclature follows Santesson et al. (2004) and Index Fungorum. Information on the frequency and distribution of all Danish taxa is provided with distributions abbreviated as noted in Table 1 (Søchting & Alstrup 2002; see also fig 1.). The exsiccate specimens were collected over a 70 year period, from 1936 to 2006. Collecting localities are mapped on fig. 2.

Table 1. Abbreviations: Distribution of exsiccate collecting localities in Denmark

SJ	South Jutland	LFM	Lolland, Falster, & Møn
EJ	East Jutland	SZ	South Zealand
WJ	West Jutland	NWZ	Northwest Zealand
NWJ	Northwest Jutland	NEZ	Northeast Zealand
NEJ	Northeast Jutland	NZ	North Zealand (NEZ+NWZ)
NJ	North Jutland (NEJ+NWJ)	Z	Zealand (NWZ+NEZ+SZ)
MJ	Central Jutland (EJ+WJ)	Ø	The islands (Z+F+LFM)
J	Jutland (NEJ+NWJ+WJ+EJ+SJ)	B	Bornholm
F	Funen and surrounding islands	A	Anholt

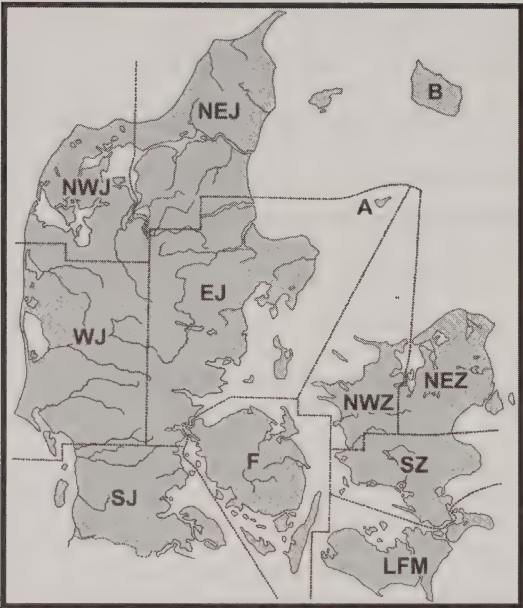


Fig.1. Map of Denmark showing the subdivision in the regions mentioned for the taxa in the species list.



Fig.2. Map of Denmark showing the localities, where the 505 numbers of "Lichenes Danici Exciccati" were collected.

Species list

- Amandinea punctata* (Hoffm.) Coppins & Scheid. (Syn.: *Buellia punctata* (Hoffm.) A. Massal.) - B,Ø,J; common: 25, 56, 133, 360, 378, 397, 426, 505.
- Anaptychia ciliaris* var. *melanosticta* (Ach.) Harm. - B; rare: 2.
- A. runcinata* (With.) J. R. Laundon (Syn.: *A. fusca* (Huds.) Vain.) - B,NZ,NEJ; rare: 85.
- Arthonia radiata* (Pers.) Ach. - B,Ø,J; common: 254.
- Bacidia rubella* (Hoffm.) A. Massal. - B,Ø,SJ,MJ,NEJ; common: 70.
- Baeomyces rufus* (Huds.) Rebert. - B,Ø,J; common: 479.
- Calicium adpersum* Pers. - SZ,NEZ,F,LFM,SJ,EJ,NEJ; endangered: 51.
- C. viride* Pers. - B,Ø,J; common: 44, 190.
- Caloplaca alstrupii* Søchting - NEZ; distribution unknown: 126.
- C. citrina* (Hoffm.) Th. Fr. - B,Ø,J; spreading: 64.
- C. holocarpa* (Hoffm. ex Ach.) A. E. Wade - B,Ø,J; common: 444.
- C. marina* (Wedd.) Zahlbr. - B,Z,F,EJ,NEJ; common: 122.
- C. thallincola* (Wedd.) Du Rietz - B,NWZ,EJ,NEJ; common: 151.
- Candelaria concolor* (Dicks.) Stein - B,Ø,J; common: 424.
- Candelariella vitellina* (Hoffm.) Müll. Arg. - B,Ø,J; common: 155.
- Cetraria aculeata* (Schreb.) Fr. - B,Ø,J; common: 38, 100, 241, 416, 443, 454, 463.
- C. islandica* subsp. *crispiformis* (Räsänen) Kärnefelt - B,Ø,J; common: 227, 301.
- C. islandica* (L.) Ach. subsp. *islandica* - B,Ø,J; common: 119, 226, 244, 467.
- C. muricata* (Ach.) Eckfeldt - B,Ø,J; common: 37, 109, 202, 473.
- Chaenotheca chlorella* (Ach.) Müll. Arg. - SZ,NEZ,F,EJ,NJ; vulnerable: 229.
- C. ferruginea* (Turner ex Sm.) Mig. - B,Ø,J; common: 86, 106, 218, 273, 280, 282, 471.
- Chrysothrix candelaris* (L.) J.R. Laundon - B,Ø,J; common: 274.
- Cladonia arbuscula* (Wallr.) Flot. subsp. *arbuscula* - B,Ø,J; common: 197.
- C. arbuscula* subsp. *mitis* (Sandst.) Ruoss - B,Ø,J; common: 364, 437.
- C. arbuscula* subsp. *squarrosa* (Wallr.) Ruoss - B,Ø,J; common: 16, 98, 108, 207, 417.
- C. caespiticia* (Pers.) Flörke - Ø,J; common: 484.
- C. cervicornis* (Ach.) Flot. subsp. *cervicornis* - B,Ø,J; common: 249.
- C. chlorophaea* (Flörke ex Sommerf.) Spreng. - B,Ø,J; common: 96, 407, 481.
- C. ciliata* Stirt. f. *ciliata* - MJ,NWJ; rare: 99.
- C. ciliata* f. *flavicans* (Flörke) Ahti & De Priest (Syn.: *C. tenuis* (Flörke) Harm.) - B,Ø,J; common: 179, 194, 206, 236, 278, 284, 318, 326, 381, 384, 409, 412, 436, 452, 462, 477.
- C. coniocraea* (Flörke) Spreng. - B,Ø,J; common: 41, 413.
- C. crispata* (Ach.) Flot. - B,Ø,J; common: 441.
- C. cryptochlorophaea* Asahina - SJ,EJ,NJ; rare: 89.
- C. digitata* (L.) Hoffm. - B,Ø,J; common: 53, 306, 414.
- C. diversa* Asperges - status B,EJ; distribution unknown: 111, 139, 191, 203, 240, 386.
- C. fimbriata* (L.) Fr. - B,Ø,J; common: 67, 125, 162, 313, 405, 501.
- C. floerkeana* (Fr.) Flörke - B,Ø,J; common: 112, 172, 213, 387.
- C. foliacea* (Huds.) Willd. - B,Ø,J; common: 13, 79, 93, 196, 201, 238, 363, 388, 439, 459.
- C. furcata* (Huds.) Schrad. - B,Ø,J; common: 14, 55, 83, 132, 166, 167, 192, 210, 211, 234, 239, 251, 270, 296, 319, 327, 382, 408, 442, 455, 464, 474.

- C. glauca* Flörke - B,Ø,J; common: 33, 94, 204, 235, 245, 268.
- C. gracilis* (L.) Willd. subsp. *gracilis* - B,Ø,J; common: 28, 107, 110, 170, 178, 193, 208, 243, 366, 415, 438.
- C. humilis* (With.) J.R. Laundon - NEZ,F,LFM,MJ,NJ; rare: 134, 390.
- C. macilenta* Hoffm. - B,Ø,J; common: 40, 73.
- C. merochlorophaea* var. *novochlorophaea* Sipman - B,EJ; common: 115, 195, 277, 279.
- C. ochrochlora* Flörke - Ø,J; common: 68, 186, 215, 250, 332, 489.
- C. polydactyla* (Flörke) Spreng. - B,Ø,J; common: 54, 137, 291, 406, 490.
- C. portentosa* (Dufour) Coem. - B,Ø,J; common: 18, 45, 74, 118, 171, 297, 365, 370, 476.
- C. pyxidata* (L.) Hoffm. - B,Ø,J; common: 103.
- C. ramulosa* (With.) J. R. Laundon (Syn.: *C. pityrea* (Flörke) Fr.) - B,Ø,J; common: 47, 214, 299, 451, 466.
- C. rangiferina* (L.) Weber ex F. H. Wigg. - B,Ø,J; common: 15.
- C. rangiformis* Hoffm. - B,Ø,J; common: 48, 209, 253, 292, 375, 389.
- C. scabriuscula* (Delise) Nyl. - B,Ø,J; common: 46, 87, 97, 116, 237, 475.
- C. squamosa* Hoffm. - B,Ø,J; common: 84, 198.
- C. subulata* (L.) Weber ex F. H. Wigg. (Syn.: *C. cornutoradiata* (Coem.) Sandst.) - B,Ø,J; common: 95, 138, 465.
- C. uncialis* (L.) Weber ex F.H. Wigg. subsp. *uncialis* - B,Ø,J; common: 29, 113, 140, 157, 168, 205, 242, 367, 410, 440, 453, 460.
- C. zopfii* Vain. - B,LFM,NWZ,MJ,NJ; common: 30, 300, 383.
- Cliostomum griffithii* (Sm.) Coppins (Syn.: *Catillaria griffithii* (Sm.) Malme) - B,Ø,J; common: 36, 62, 266, 310, 494.
- Collemopsidium sublitorale* (Leight.) Grube & B.D. Ryan (Syn.: *Pyrenocollema sublitorale* (Leight.) R.C. Harris ex A. Fletcher) - NEZ,SJ,EJ; rare: 52.
- Evernia prunastri* f. *herinii* (P.A. Duvern.) D. Hawksw. - F,NEZ; rare: 72, 105, 180.
- E. prunastri* (L.) Ach. f. *prunastri* - B,Ø,J; common: 39, 165, 252, 259, 287, 303, 333, 480, 493.
- Flavocetraria nivalis* (L.) Kärnefelt & A. Thell - B,LFM,Z,MJ,NJ; rare: 101.
- Graphis scripta* (L.) Ach. - B,Ø,J; common: 257.
- Haematomma ochroleucum* var. *porphyrium* (Pers.) J.R. Laundon - B,Ø,EJ,NEJ; spreading: 161, 272, 314, 335, 337, 396, 421, 492, 504.
- Hypocenomyce scalaris* (Ach.) M. Choisy - B,Ø,EJ,NEJ; spreading: 23, 58, 188, 411, 420, 472.
- Hypogymnia physodes* (L.) Nyl. - B,Ø,J; common: 60, 104, 114, 173, 199, 233, 293, 368, 385.
- H. tubulosa* (Schaer.) Hav. - B,Ø,J; common: 31, 174, 304.
- Imshaugia aleurites* (Ach.) S.L.F. Mey. (Syn.: *Parmeliopsis aleurites* (Ach.) Nyl.) - B,Ø,MJ,NEJ; rare: 69.
- Lasallia pustulata* (L.) Mérat - B,NEJ; endangered: 17, 141, 176.
- Lecanactis abietina* (Ach.) Körb. - F,J; rare: 231.
- Lecanora argentata* (Ach.) Malme - B,Ø,J; rare: 129, 255, 308, 328.
- L. chlarotera* Nyl. - B,Ø,J; common: 286, 353.
- L. conizaeoides* Nyl. ex Cromb. - B,Ø,J; spreading: 20, 135, 224.
- L. dispersa* (Pers.) Röhl. - B,Ø,J; common: 65.

- L. expallens* Ach. - B,Ø,J; spreading: 42, 330, 401, 403, 419.
- L. glabrata* (Ach.) Malme - B,NEZ,MJ,NEJ; rare: 376.
- L. polytropa* (Ehrh. ex Hoffm.) Rabenh. - B,Ø,J; common: 153.
- L. rupicola* (L.) Zahlbr. - B,Ø,J; common: 150.
- L. sp.* - 377.
- L. xanthostoma* Cl. Roux ex Fröberg - NEZ,EJ,NEJ; rare: 276.
- Lecidella achristotera* (Nyl.) Hertel & Leuckert - B,Ø,J; common: 434.
- L. elaeochroma* (Ach.) M. Choisy - B,Ø,J; common: 131, 185, 187, 221, 263, 355, 447.
- L. euphorea* (Flörke) Hertel - LFM,Z,MJ,NEJ; rare: 262.
- Lepraria incana* (L.) Ach. - B,Ø,J; common: 102, 189, 217, 281, 283, 288, 316, 317, 341, 351, 357, 391, 404, 418.
- Leproloma membranaceum* (Dicks.) Vain. - B,NEJ; rare: 148.
- Leptogium lichenoides* (L.) Zahlbr. - B,Ø,J; rare: 11.
- Lichen sp.* - 491.
- Lichenoconium xanthoriae* M.S.Christ. - B,Ø,J (?); common: 66.
- Melanelixia fuliginosa* (Fr. ex Duby) O. Blanco et al. subsp. *fuliginosa* - B,Ø,J; common: 152.
- M. fuliginosa* subsp. *glabrata* (Lamy) J.R. Laundon - B,Ø,J; common: 373, 379, 435, 485, 143, 225, 256, 320.
- M. subaurifera* (Nyl.) O. Blanco et al. - B,Ø,J; common: 309, 488.
- Micarea denigrata* (Fr.) Hedl. - B,Z,F,J; common: 285.
- Nephroma laevigatum* Ach. - B,SZ,NEZ,F,J; vulnerable: 4, 10.
- Ochrolechia frigida* (Sw.) Lynge - B,J; rare: 181.
- O. microstictoides* Räsänen - NEZ,NEJ; distribution unknown: 35.
- O. turneri* (Sm.) Hasselrot - Z,J; common: 123.
- Opegrapha atra* Pers. - B,Ø,J; common: 354.
- O. niveoatra* (Borrer) J.R. Laundon - B,Ø,J; rare: 352.
- O. rufescens* Pers. - B,Ø,SJ,EJ,NEJ; rare: 216, 275, 339.
- O. varia* Pers. - B,Ø,J; common: 267.
- Parmelia omphalodes* (L.) Ach. - B,NJ,A; rare: 12, 149, 298.
- P. saxatilis* (L.) Ach. - B,Ø,SJ,MJ,NEJ; common: 8, 78, 145, 169, 307, 334, 342, 422.
- P. sulcata* Taylor - B,Ø,J; common: 22, 88, 92, 219, 329, 331, 345, 371, 428, 486, 497.
- Parmelina pastillifera* (Harm.) Hale (distributed as *Parmelina tiliacea* (Hoffm.) Hale) - B,SZ; endangered: 3 (Hansen 2005).
- Parmeliopsis hyperopta* (Ach.) Arnold (Syn.: *Foraminella hyperopta* (Ach.) S.L.F. Mey.) - B,NZ,J; rare: 50.
- Peltigera hymenina* (Ach.) Delise - B,Ø,J; rare: 32, 305.
- P. membranacea* (Ach.) Nyl. - B,Ø,J; rare: 9, 61, 269.
- P. neckeri* Hepp ex Müll. Arg. - B,Ø,J; rare: 448.
- P. praetextata* (Flörke ex Sommerf.) Vain. - B,Ø,J; rare: 63.
- P. rufescens* (Weiss) Humb. - B,Ø,J; rare: 461.
- Pertusaria albescens* (Huds.) M. Choisy & Werner - B,Ø,J; common: 356.
- P. amara* (Ach.) Nyl. - B,Ø,J; common: 128, 336, 446, 487.
- P. coccodes* (Ach.) Nyl. - B,Ø,J; common: 321, 338.
- P. leioplaca* DC. - B,Ø,EJ,NEJ,SJ; rare: 127.
- P. pertusa* (Weigel) Tuck. - B,Ø,J; common: 222, 258, 343, 358.

- Phaeophyscia orbicularis* (Neck.) Moberg - B,Ø,J; common: 1, 24, 59, 372, 395, 427, 430.
- Phlyctis argena* (Spreng.) Flot. - B,Ø,J; common: 158, 160, 184, 223, 264, 271, 295, 433, 482, 499.
- Physcia adscendens* (Fr.) H. Olivier - B,Ø,J; common: 21, 130, 159, 431, 502.
- P. caesia* (Hoffm.) Fűrnr. - B,Ø,J; common: 325.
- P. tenella* var. *marina* (A. Nyl.) Lynge - B,NWZ,EJ,NEJ; rare: 449.
- P. tenella* (Scop.) DC. var. *tenella* - B,Ø,J; common: 26, 163, 228, 265, 294, 349, 392, 402, 425, 495, 498.
- Physconia distorta* (With.) J. R. Laundon (Syn.: *P. pulverulacea* Moberg) - B,Ø,J; common: 260, 290.
- P. enteroxantha* (Nyl.) Poelt - B,Ø,J; common: 136.
- P. grisea* (Lam.) Poelt - B,Ø,J; common: 323, 344, 359, 374, 394.
- Placynthiella icmalea* (Ach.) Coppins & P. James - B,Ø,J; common: 175, 230.
- Platismatia glauca* (L.) W.L. Culb. & C.F. Culb. - B,Ø,J; common: 120, 147, 200, 468, 483.
- Pleurosticta acetabulum* (Neck.) Elix & Lumbsch - B,Ø,J; common: 261, 322, 348, 423 (Hellbom 1890).
- Pseudevernia furfuracea* (L.) Zopf var. *furfuracea* - B,Ø,J; common: 117, 121, 142, 164, 212, 248, 450, 470.
- Pseudosagedia aenea* (Wallr.) Hafellner & Kalb (Syn.: *Porina aenea* (Wallr.) Zahlbr.) - B,Ø,J; rare: 315, 500.
- P. chlorotica* (Ach.) Hafellner & Kalb (Syn.: *Porina chlorotica* (Ach.) Müll. Arg.) - B,Ø,J; rare: 432.
- Ramalina cuspidata* (Ach.) Nyl. - B; common: 77.
- R. farinacea* (L.) Ach. - B,Ø,J; common: 6, 302, 311.
- R. fastigiata* (Pers.) Ach. - B,Ø,J; spreading: 124, 289, 312, 361, 380.
- R. pollinaria* (Westr.) Ach. - B,Ø,J; rare: 247.
- R. polymorpha* (Lilj.) Ach. - B,SZ,NEZ,F,EJ,NJ; rare: 5.
- R. siliquosa* (Huds.) A.L. Sm. - B,Ø,J; rare: 7, 246.
- Rhizocarpon geographicum* (L.) DC. - B,Ø,J; rare: 154.
- R. lecanorinum* Anders - B,NEZ,F,SJ,MJ,NEJ; rare: 144.
- R. obscuratum* (Ach.) A. Massal. - B,Ø,J; common: 90.
- R. richardii* (Lamy ex Nyl.) Zahlbr. (Syn.: *R. constrictum* Malme) - B,F; rare: 81.
- Stereocaulon dactylophyllum* Flörke - B,NEZ,F,SJ,EJ,NEJ; vulnerable: 458.
- S. evolutum* Graewe - B,NZ,SJ,MJ,NEJ; rare: 146.
- S. nanodes* Tuck. - NEZ; rare: 456.
- S. saxatile* H. Magn. - B,NZ,J; rare: 27.
- S. vesuvianum* Pers. - NJ,A; rare: 457.
- Stigmidium marinum* (Deakin) Swinscow - B,NWZ,EJ,NEJ; rare: 177.
- Taeniolella cladiniicola* Alstrup - NWJ (?); rare: 57.
- Tephromela atra* (Huds.) Hafellner - B,Ø,J; common: 80.
- Trapeliopsis flexuosa* (Fr.) Coppins & P. James - B,Ø,J; common: 91.
- T. granulosa* (Hoffm.) Lumbsch - B,Ø,J; common: 43.
- Tuckermanopsis chlorophylla* (Willd.) Hale (Syn.: *Cetraria chlorophylla* (Willd.) Vain.) - B,Ø,J; common: 34.

- Umbilicaria polyphylla* (L.) Baumg. - B,F,MJ,NJ; rare: 82.
Verrucaria maura Wahlenb. - B,Ø,J; common: 156.
V. nigrescens Pers. - B,Ø,J; common: 445.
Xanthoparmelia conspersa (Ach.) Hale - B,Ø,J; rare: 76, 350.
X. loxodes (Nyl.) O. Blanco et al. - B,Ø,J; rare: 346.
X. tinctina (Maheu & A. Gillet) Hale - NEJ; vulnerable: 347.
Xanthoria candelaria (L.) Th. Fr. - B,Ø,J; common: 324, 362, 398, 429, 503.
X. fulva (Hoffm.) Poelt & Petut. - F, EJ; rare: 400.
X. parietina (L.) Th. Fr. - B,Ø,J; common: 19, 75, 183, 340, 369, 393, 469, 478.
X. poeltii S.Y. Kondr. & Kärnefelt - B,Z,F,SJ,EJ,NJ; common: 399.
X. polycarpa (Hoffm.) Th. Fr. ex Rieber - B,Ø,J; common: 49, 182, 220, 232, 496.
Xanthoriicola physciae (Kalchbr.) D. Hawksw. - B,Ø,J (?); common: 71.

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New species and new record of foliicolous lichenized fungi from Sikkim (India)

ATHOKPAM PINOKIYO & KRISHNA PAL SINGH

pinkiahokpam@gmail.com

Botanical Survey of India, Central Circle

Allahabad- 211 002, India

Abstract—*Aderkomyces sikkimensis* and *Thelenella indica* are described from Sikkim, India. *Echinoplaca streimannii* is reported for the first time from India.

Key words—interesting taxa, lichens

Introduction

Sikkim, a small state covering an area ca 7,096 sq. km in the North-Eastern region of India, harbours a rich flora of lichenized fungi (Sinha & Singh 2006). In the course of studies on foliicolous lichen collections made from tropical and subtropical forests of the North-Eastern region, many interesting findings (Singh & Pinokiyo 2003, 2004, Pinokiyo et al. 2004, Pinokiyo & Singh 2004) have already been published. As a part of our ongoing studies, the foliicolous collections from Sikkim area have resulted in the presence of two taxa of lichenized fungi new to science and one taxon as new to lichen flora of India.

Materials and methods

The specimens were collected by the first author (Pinokiyo) in Sikkim Himalaya. The morphological observations were made using a 10x hand lens. Sections of ascocarps were cut by hand with the help of sharp blades and mounted in potassium hydroxide (10% KOH), iodine (I) and lactophenol cotton blue solutions and examined under compound microscope (ELEITZ WETZLAR, Germany) 10x, 45x and 100x (oil immersion) magnifications. All microscopic measurements were taken in 10% KOH.

Result and discussion

The study revealed the following two new foliicolous species, one each of *Thelenella* and *Aderkomyces* and one species of *Echinoplaca* as new record from India.

Aderkomyces sikkimensis Pinokiyo, Kr.P. Singh & Lücking sp. nov.

FIGURES 1A & 2A

Thallus foliicolus, tennuis, cinereus, verrucosus; pilis sterilis numerosae albis ad brunneolis et extremum nigricantis. Algae ad Chlorococcaceas pertinens. Apothecia adnata, basi levissime constricta, 0.3–0.5 mm diam., rubra-fuscescentia; disco plano ad minute convexo, epruinoso; margine indistincte. Paraphyses hyalinae, ramosae et anastomosantes. Asci 1-spори. Ascospores hyalinae, oblongae–ellipsoideae, muriformes, 28–40 × 15–26 µm.

Type: India, Sikkim, South Sikkim district, Damthang, subtropical forest, Pinokiyo, F 430. Holotype: (CAL); West Bengal, Darjeeling district, Tin mile, subtropical forest, Pinokiyo, F 167 A. Paratype: (BSA).

Thallus epiphyllous, thin, grey, centrally continuous, with dispersed peripheral region, verrucose, provided with many sterile hairs, 30–40 mm across, 20–40 µm thick; verrucae with numerous crystals within; sterile hairs tapering, whitish to brownish and finally blackish, 0.5–1 mm long. Photobiont—a species of *Chlorococcaceae*; algal cells rounded, greenish, 8–14 µm in diam.

Apothecia adnate, at least slightly constricted at base, circular, red-brown, developed above thallus layer, 0.3–0.5 mm in diam., 90–100 µm high; algal cells usually absent in the thallus below the apothecium; disc plane to slightly convex, epruinose, margin indistinct; excipulum colourless, made up of hyaline branched fungal hyphae, 20–36 µm thick laterally, usually reduced in central region below the hypothecium, thin, 4 to 8 µm thick; hypothecium pale yellowish, 10–18 µm thick; epithecium brown, 2–4 µm thick; hymenium 45–60 µm thick, KI–; paraphyses hyaline, richly branched and anatomosed, ca 1 µm thick. Asci saccate, thin walled, unitunicate, single spored, 32–45 × 18–30 µm. Ascospores colourless, muriform, oblong–ellipsoid, 28–40 × 15–26 µm.

Hyphophores not seen.

Remark: The species can easily be characterized by its finely verrucose thallus and red-brown apothecia. It is closest to *Aderkomyces verrucosus* (Sérus.) Lücking et al. and *A. verrucifer* (Lücking) Lücking et al. (as ‘verruciferus’) but can be distinguished from *A. verrucosus* by its red brown apothecia and finely verrucose thallus and from *A. verrucifer* by its finely verrucose thallus and longer setae.

Additional specimen examined: India, Sikkim, South Sikkim district, Temi, subtropical forest, Pinokiyo F 398 A (BSA).

Thelenella indica Pinokiyo & Kr.P. Singh sp. nov.

FIGURES 1B & 2C

Thallus foliicolus, cinereo-brunneus, laevigatus, verrucosus. Algae ad Chlorococcaceas pertinentes. Perithecia immersa, cum thallis concolora, 0.15–0.18 × 0.09–0.12 µm, lenticularia ad subglobosa; involucrellum absens; hamathecium KI–; paraphyses et periphysodes hyalinae, ramosae et anastomosantes. Asci 4–8-spори, bitunicati. Ascospores hyalinae, ellipsoideae ad oblongae, submuriformes ad muriformes, (16–) 25–40 × 7–12 µm.

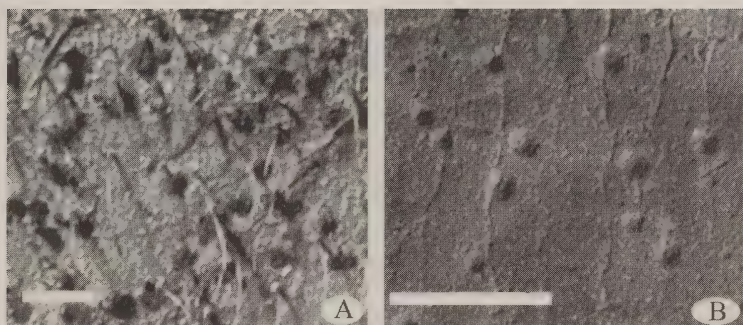


Fig. 1. Habits (A) *Aderkomyces sikkimensis* (holotype), (B) *Thelenella indica* (holotype).

Scale = 1 mm

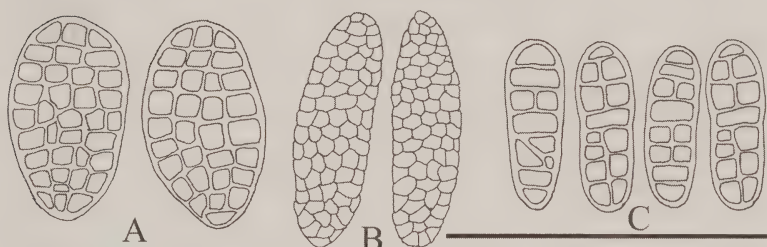


Fig. 2. Ascospores (A) *Aderkomyces sikkimensis* (holotype), (B) *Echinoplaca streimannii* (C) *Thelenella indica* (holotype). Scale = 50 μ m.

Type: India, Sikkim, East Sikkim district, Assam-Linzey Road, in tropical forest, on the leaves of a small tree (ca 1m) of *Schima wallichii* (DC.) Korth in sub-shady place, Pinokiyo, F 315. Holotype: CAL; Isotype: ASSAM, BSA.

Thallus crustaceous, foliicolous, ecorticate, greyish-brown, verrucose, continuous, thicker near perithecium, gradually thinner towards periphery, 20–120 μ m thick; fungal hyphae 2–3 μ m thick; verrucae small, blackish; hypothallus indistinct. Photobiont a species of *Chlorococcaceae*, cells rounded, 6–12 μ m in diam., green, found in groups of 5–18 cells, intermingled with fungal hyphae.

Perithecia covered by thallus, concolorous with the thallus, lens shaped to subglobose, 0.15–0.18 $\times$ 0.09–0.12 mm in size; involucrellum absent; excipulum paraplectenchymatous, brownish near apical region, 25–30 μ m thick, colourless to brownish laterally and at base, ca 15 μ m thick; hamathecium KI–; paraphyses and periphysoides thin, branched and anastomosing, ca 0.7 μ m thick. Asci 4–8 spored, clavate, bitunicate, 40–55 $\times$ 15–30 μ m. Ascospores colourless, ellipsoid to oblong, submuriform to muriform, transversely 3–7-septate, longitudinally 0–2 septate, (16–) 25–40 $\times$ 7–12 μ m.

Remark: The genus *Thelenella* monographed by Mayrhofer (1987), was characterized by crustose thallus, perithecia immersed in the thalline warts, often absence of an open involucrellum, branched and anastomosing paraphyses and periphysoids, hyaline to brownish, submuriform to muriform ascospores. A single foliicolous species, *Thelenella fusispora* Vězda & H. Mayrhofer, from Tanzania was recorded. The present find of another foliicolous taxon is an interesting addition to the genus. *T. fusispora* is distinguished by its larger (0.3–0.4 mm) perithecia, larger ($45\text{--}65 \times 17\text{--}23 \mu\text{m}$) muriform ascospores with 11–15 transverse and 2–3 vertical (longitudinal) septa.

Echinoplaca streimannii Sérus. in Aptroot et al., Biblioth. Lichenol. 64: 59, 1997.

FIGURE 2 B

This species can be characterized by continuous, very finely verrucose (silvery grey) thallus without hyphophores and sterile hairs, adnate, greyish brown, 0.2–0.5 mm wide apothecia, 2–4-spored asci and colourless, muriform, oblong–ellipsoid, ascospores.

The Indian material has slightly smaller ascospores ($35\text{--}40 \times 12\text{--}14 \mu\text{m}$) than described for the species. It belongs in the group centered around *Echinoplaca lucernifera* Kalb & Vězda. This species somewhat resembles *Echinoplaca vezdana* Lücking & Kalb, which has very coarsely verrucose thallus and much larger, lighter apothecia and much more elongate ascospores. The species grows all over the leaf surface or sometimes found associated with *Gyalectidium flicinum* Müll. Arg. and species of *Strigula*. It was described from Papua New Guinea (Aptroot et al. 1997).

Specimens examined: India, Sikkim, South Sikkim dist., subtropical forest, Damthang, Pinokiyo, F 421 A, F 420, F 429, F 455, F 456, 455; Temi, subtropical forest, Pinokiyo, F 401, F 469; West Sikkim dist., Kacheopalri, Pinokiyo F 518, F 509, F 511.

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**Notes on taxonomy and distribution of the lichen species
Lepraria ecorticata comb. nov.¹**

MARTIN KUKWA

dokmak@univ.gda.pl

*Department of Plant Taxonomy and Nature Conservation, University of Gdansk
Al. Legionów 9, PL-80-441 Gdansk, Poland*

Abstract—The combination *Lepraria ecorticata* is proposed. This species is reported as new to Asia, and South America and additional records from the Czech Republic and Poland are presented. Earlier records of *Lecanora leuckertiana* from Poland and the Czech Republic represent *L. ecorticata*.

Key words— *Lecanora ecorticata*

Lepraria Ach. is a widely distributed genus and comprises ca. 40 taxa (Laundon 1989, 1992; Tønsberg 1992, 2004; Lohtander 1994, Leuckert et al. 1995, Aptroot et al. 1997, Aptroot 2002, Sipman 2004, Elix 2006a). Anatomy and morphology of the thallus are very simple. It consists of soredia (sometimes called granules) laying on medulla or directly on a layer of hypothalline hyphae (Tønsberg 1992). The edge of the thallus may be diffuse or minutely to markedly lobate. All species are only known in the sterile state (Tønsberg 1992, Sipman 2004). The chemistry is very diverse and substances from many groups have been reported, with the exception of chromones and xanthonones (Leuckert et al. 1995, Elix & Tønsberg 2004, Elix 2006b).

After Laundon's revision of *Lepraria* (Laundon 1992), all taxa with usnic acid and a leprarioid thallus were excluded from the genus and referred to *Lecanora* Ach. (Laundon 1992, 2003; Zedda 2000). More recently Sipman (2003) described *Lepraria usnica* with usnic acid from the tropics. He included this taxon in *Lepraria* based on the very similar morphology to other lobate species. He also pointed out that the presence or absence of usnic acid with zeorin is not a good discriminator of lichens at the generic level. He cited the genus *Cladonia* Hill ex P. Browne for comparison as this also includes taxa with and without usnic acid and zeorin in the thallus. Subsequently, Sipman (2004) transferred *Lecanora coriensis* (Hue) J.R. Laundon to *Lepraria*, as *L. coriensis* (Hue) Sipman.

During field studies in Poland the author found a leprarioid lichen with usnic acid and zeorin (and sometimes traces of atranorin detected by TLC),

growing on rocks and more rarely on bark which looked similar to *Lecanora ecorticata*. Although the type collection was not available, other specimens cited by Laundon (2003) were studied. The collections from Poland proved to be identical with the latter in all respects, and it appeared appropriate that this species should be transferred to *Lepraria*.

Lepraria ecorticata* (J.R. Laundon) Kukwa **comb. nov.*

Basionym: *Lecanora ecorticata* J.R. Laundon, Nova Hedwigia 76(1–2): 100. 2003.

L. ecorticata has a typical *Lepraria*-like thallus, very similar in appearance to *L. elobata* Tønsberg, and grows in habitats sheltered from direct rain, together with e.g. the former species and *L. rigidula* (de Lesd.) Tønsberg. It is quite similar to *Lecanora* species containing usnic acid and an almost entirely sorediate thallus, e.g. *L. expallens* Ach. or *L. compallens* Herk & Aptroot. However, they differ in the presence of an endo- to episubstratal, usually continuous prothallus and of soredia formed in delimited soralia at least in the young part of the thallus. These characters of *L. ecorticata* confirm the placement in *Lepraria*.

Previously *L. ecorticata* was known from the British Isles and Canada (Laundon 2003), but is now reported as new to continental Europe, South America (Chile) and Asia (China).

In Poland and the Czech Republic this species has previously been recorded as *Lecanora leuckertiana* Zedda (Bayerová & Kukwa 2003, Czarnota 2002). The former authors noted that the morphology of their specimens differed from the type of *L. leuckertiana*, and these specimens can now be identified as *Lepraria ecorticata*. Additional records of *L. ecorticata* from both countries are presented below. In particular, these two species differ in the thallus organisation and the appearance of soredia: *Lecanora leuckertiana* has a woolly, thick and stratified thallus with soredia intermixed with abundant medullary hyphae, whereas *Lepraria ecorticata* usually has a thick, not stratified thallus with most medullary hyphae and soredia well separated from one another.

Lepraria straminea Vain. is another morphologically and chemically (usnic acid and zeorin) similar taxon (Øvstedal & Lewis Smith 2001). However, it differs in having corticate granules and it looks very much like a yellowish member of the *L. neglecta* group. It is considered to be an Antarctic endemic (Øvstedal & Lewis Smith 2001).

SPECIMENS EXAMINED—*Lepraria ecorticata*. **CHILE.** Parque Nacional Puyehue. ANTICURA, LOS DERRUMBES, ALT. 600 M (72°10'E, 40°40'S), on rock—1986 Coppins, Galloway, Guzmán, James 4643 (BM). **CHINA.** XIAMEN: FUJIAN PROVINCE, ALT. 100 M, on tree bark—1998 Abbas (UGDA-L-9170). **POLAND.** Bielska Plain. BIAŁOWIEŻA NATIONAL PARK, FOREST SECTION No. 370, on *Acer platanoides*—III.2001 Kukwa 180 (UGDA-L-6511). FOREST SECTION No. 256, on *Acer platanoides*—30.III.2001 Kukwa 471 (UGDA-L). FOREST SECTION No. 371C (23°51'59"E, 52°43'24"N), on *Tilia cordata*—

02.V.2004 Kukwa 3236 (UGDA-L-10240). **Gorce Mts.** GORCZAŃSKI NATIONAL PARK, ŁOPUSZANKA VALLEY, ALT. CA. 830 M, on sandstone—01.V.1999 Kukwa (UGDA-L-9666). **Kaszuby Lakeland.** KRĘGI KAMIENNE NATURE RESERVE (17°50'23"E, 54°12'58"N), on stone—07.III.2004 Kukwa 2921 (UGDA-L-11107). **Sowie Mts.** SREBRNA GÓRA MT. (16°38'45"E, 50°34'32"N), on rock—22.IV.2004 Kukwa 3104 (UGDA-L-10290). **Karkonoskie Foothills.** CA. 0.5 KM W OF MICHAŁOWICE (15°35'9"E, 50°50'45"N), on stone—09.VII.2003 Czarnota (UGDA-L-10173). VICINITY OF MICHAŁOWICE, ALT. 560 M (15°34'59"E, 50°50'45"N), on granite—09.VII.2003 Czarnota (UGDA-L-10509). **Warmia.** GLUCH, on *Alnus glutinosa*—10.V.1976 Olesiński (KRAM-L-30726). **Beskid Wyspowsy Mts.** ŚNIEŻNICA MT, ALT. 970 M, on rock—11.VIII.1966 Nowak (KRAM-L-5850). **CZECH REPUBLIC.** Rychlebské Horý Mts. BÍLÁ VODA STREAM VALLEY, CA. 3 KM S OF BÍLÁ VODA TOWN, ŠAFÁŘOVA SKÁLA ROCK, on rocks—24.IV.2004 Kukwa 3179 (UGDA-L-11755). **Protected Landscape Area Křivoklátsko.** ÚPOŘSKÝ POTOK STREAM VALLEY, NATIONAL NATURE RESERVE TÝŘOV (13°48'09"E, 49°57'59"N), on rock—22.IV.2005 Kukwa 3874 (UGDA-L-11898). TYTERSKÝ STREAM VALLEY, VALACHOV NATURE RESERVE (13°46'24"E, 50°01'10"N), on rock—23.IV.2005 Kukwa 3894 (UGDA-L-11907).

ADDITIONAL SPECIMENS EXAMINED—*Lecanora compallens* (selected specimens; a total number of 17 collections examined). **GERMANY. BAVARIA:** LECHAUEN—pre 1907 s.coll. (BM). **POLAND. Hawa Lakeland.** WATKOWICE DUŻE, on *Acer platanoides*—01.IX.1997 Kukwa (UGDA-L-6217). S OF SZADOWO (19°03'14"E, 53°46'24"N), on *Ulmus*—12.IV.2004 Kukwa 3054 (UGDA-L-10265). **Beskid Mały Mts.** STREAM VALLEY BY OKRĘGELAK, 500 M, on *Acer pseudoplatanus*—05.X.1962 Nowak (KRAM-L-10015). *Lecanora expallens* (selected specimens; a total number of 142 collections examined). **CZECH REPUBLIC. SBOHEMIA:** CA. 2.5 KM E OF MIROCHOV, on *Acer pseudoplatanus*—12.IV.2002 Kukwa 1402 (UGDA-L-8737). **GERMANY. BADEN:** ODENWALD, ZWINGENBERG/NECKAR, ALT. 200 M, on *Acer pseudoplatanus*—27.IV.1978 Wirth 6683 (BM). **POLAND. Sandomierska Basin.** JANOWSKIE FOREST (22°27'E, 50°37'N), on *Quercus*—08.IX.1999 Bielczyk (KRAM-L-44976). **Sławnieńska Plain.** KRZESZEWO NEAR SŁAWNO, on *Quercus*—29.VIII.1987 Fałtynowicz, Miądlikowska (SLTC, fertile). **Gnieźnieńskie Lakeland.** LUBOSTRŃ, on *Acer pseudoplatanus*—IX.2004 Kukwa 3542 (UGDA-L-11217, KRAM). **Kaszuby Coast.** GDAŃSK OLIVA, KOŚCIERSKA STREET, on *Acer platanoides*—31.V.2003 Kukwa 1826a (UGDA-L-10631). **Hawa Lakeland.** 2 KM N OF GOŚCISZEWO, on *Populus nigra*—18.III.2001 M. Kukwa 105 (UGDA-L-12519, BG). **Olsztyn Lakeland.** Olsztyn Dajtki, on *Alnus glutinosa*—30.IX.2002 Kubiak (OLTC). **Słowińskie Coast.** W OF KARWIA, on *Quercus*—12.VIII.1967 Sulma (UGDA-L-3815, fertile). **Wieluń Upland.** KRZEMIONKI MT., on *Salix*—17.IX.1997 Śliwa, Czarnota, Kukwa, Leśniański, Adamska (LOD-L-11188). *Lecanora leuckertiana*. **ITALY. SARDINIA:** ILLORAI, M. ARTU, ALT. 840 M, on *Quercus pubescens*—09.04.1997 Zedda 1800 (HOLOTYPE-B). *Lepraria straminea*. **ANTARCTICA. SOUTH SHETLAND: Admiralty Bay.** NEAR PORT THOMAS, NEAR SEA LEVEL, on soil—21.I.1937 Discovery Exped. 1936–711 (BM).

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An appraisal of the syntype material of *Caloplaca aurantiomurorum* (*Teloschistaceae*, lichenized fungi)

JAN VONDRÁK* & JAROSLAV ŠOUN

*j.vondrak@seznam.cz

Department of Botany, Faculty of Biological Sciences
University of South Bohemia

Branišovská 31, CZ-370 05, České Budějovice, Czech Republic

Abstract—Sample no. 54 of Flagey: Lichenes Algerienses exsiccati represents the syntype of *Placodium aurantiomurorum* (= *Caloplaca aurantiomurorum*). However, the samples of this exsiccatum distributed to FH, H, M, PC and UPS contain different lichen species. The lectotype of *P. aurantiomurorum* is selected here (sample in UPS) and this name is treated as a synonym to *Caloplaca aurantia*. In this exsiccatum, *Candelariella senior* has been identified (in H, FH, and PC), which is reported here as a new species to Algeria. The known distribution of *Can. senior* is described.

Key words—lichens, nomenclature, typification

Introduction

Placodium aurantiomurorum was described by Flagey (1891: 112) from Algeria “Rochers humides de Sidi-Mecid et seulement là”) in the exsiccatum “Flagey: Lichenes Algerienses exsiccati (no 54)”. This exsiccate collection was distributed to the herbaria FH (nos 1-200), H, M, PC, and UPS (Grummann 1974: 277). The specimen in the herbarium of the University of Helsinki (H) was investigated, it being the only representative of *Caloplaca aurantiomurorum* (Flagey) Zahlbr. in the section. Surprisingly, it clearly belonged to the genus *Candelariella*, which we later determined as *Can. senior* Poelt. Subsequently, we investigated more samples of this exsiccatum (FH, M, PC, UPS) and found that individual exsiccates represent different species of *Caloplaca* (= *Cal.*) and *Candelariella* (= *Can.*).

Materials and Methods

Apart from the investigated exsiccates, reference materials of *Caloplaca aurantia* (Pers.) Hellb., *Cal. flavescens* (Huds.) J.R.Laundon, *Cal. saxicola* (Hoffm.)

Nordin, and *Candelariella senior* from the herbaria CBFS, GZU, M, PRC, and PRM were used. Light microscopy measurements of ascospore characteristics, to an accuracy of 1 μm , were performed on hand-made sections examined in water at a magnification of $\times 1000$. These measurements are given as MIN-X ($\pm$ SD)–MAX, where X = mean value, SD = standard deviation, and MIN and MAX = extremes. Ten measurements (five ascospores in two apothecia) were examined in all samples except that from H, where the numbers of measurements (n) are given in parentheses.

Results

The material in FH has a yellow-orange, rosette-like thallus with broad and flat lobes. Mature, well-developed ascospores are citriform, 12–14.2 (± 1.1)–16 $\times$ 8–9.3 (± 0.7)–10 μm , with septa 3–4.2 (± 0.6)–5 μm wide. This specimen is morphologically identical with typical *Caloplaca aurantia*. *Candelariella senior* (morphologically identical with the material from H) and a small piece of an undetermined *Caloplaca* with a granular thallus are also present in this collection.

The material in H has *Candelariella*-type asci, simple ascospores, and a thallus and apothecia devoid of anthraquinones; therefore it belongs to *Candelariella*, not to *Caloplaca*. This rosette-like lichen was morphologically and anatomically compared with the holotype specimen of *Candelariella senior* (M, 0099854). Both samples are identical in most characters, differences were only observed in the thallus thickness [100–170 (± 44)–250 μm (n=12) in “*Cal. aurantiomurorum*” vs. 120–228 (± 66)–310 μm (n=10) in *Can. senior*] and in the spore width [10–12.5 (± 1.2)–15 $\times$ 4–5.3 (± 0.6)–6 μm (n=18) in “*Cal. aurantiomurorum*” vs. 10–12.0 (± 1.7)–16 $\times$ 3–4.0 (± 0.5)–5 μm (n=10) in *Can. senior*].

The material in M (M-0100101) has an orange, rosette-like thallus with short broad marginal lobes. Mature ascospores are ellipsoid, never citriform, 10–11.0 (± 0.5)–12 $\times$ 6–6.1 (± 0.3)–7 μm , with septa 3–3.4 (± 0.5)–4 μm wide. This specimen is morphologically identical with typical *Caloplaca saxicola*.

The material in PC (PC0107050) is on two pieces of stone (glued on a sheet). The upper one is only covered by a fertile lichen with yellow-orange, rosette-like thallus with broad and flat marginal lobes. Mature, well-developed ascospores are citriform 13–14.1 (± 1.2)–16 $\times$ 9–10.4 (± 1.0)–12 μm , with septa 4–4.5 (± 0.7)–6 μm wide. This specimen is morphologically identical with typical *Caloplaca aurantia*. The lichenicolous fungus *Cercidospora caudata* Kernst. occurs in its apothecia. *Cal. aurantia* also prevails on the lower stone, but *Candelariella senior* and an undetermined granulose *Caloplaca* are admixed.

The material in UPS has a yellow-orange, rosette-like thallus with broad and flat lobes. Mature, well-developed ascospores are citriform, 13–14.6 (± 0.8)–16

$\times 8-9.7 (\pm 0.9)-11 \mu\text{m}$, with septa $4-4.9 (\pm 0.7)-6 \mu\text{m}$ wide. This specimen is morphologically identical with typical *Caloplaca aurantia*. This sample is selected here as the lectotype.

Discussion

The short Latin diagnosis of *Placodium aurantiomurorum* (Flagey 1891: 112) is translated as follows: "Thallinal lobes flatter than in *P. murorum* (= *Caloplaca saxicola*); spores $16-18 \times 8-9 \mu\text{m}$, wider than in *P. murorum* and with a shape as in *Physcia aurantia* (= *Cal. flavescens*)". The extended French description (Flagey 1896: 28), where *Placodium aurantiomurorum* was compared with *P. murorum*, *P. callopismum* (= *Cal. aurantia*) and *P. heppianum* (= *Cal. flavescens*), is translated as follows: "Thallus fairly yellow suede with lobes larger and more flattened than in *P. murorum*, resembling lobes of *P. callopismum*, but with lobes yellow, less reddish. Spores ovoid, 'placodial' $16-18 \times 8-9 \mu\text{m}$, larger than in *P. murorum*, strongly resembling spores of *P. heppianum*, whose thallus is clearly different".

Based on these descriptions, *Cal. aurantiomurorum* is distinct from *Cal. saxicola* by having a different shape and size of the thallus and a different shape of spores and from *Cal. flavescens* by having a different shape of lobes. However, *Cal. aurantiomurorum* is distinguished from *Cal. aurantia* only by the yellow colour of the thallus. Based on this and the syntype investigation, we decided to place the name *Cal. aurantiomurorum* into the synonymy of *Cal. aurantia*.

In the protologue, Flagey (1891: 112) described one locality but did not designate the holotype. His main herbarium is located in PC and following the usual practice for exsiccates, the sample placed there should be regarded as the holotype and the others as isotypes. In this case, however, due to the heterogeneity of the respective material, we treat all exsiccate samples as syntypes. We have selected the sample in UPS as the lectotype, because it is well-preserved and without any admixture of similar lichen species (cf. the mixture represented by the specimen in PC). The sample in UPS was already revised as *Cal. aurantia* and mentioned in the list of exsiccates of this species by Nordin (1972: 80). This specimen was indicated as an isotype although the typification was not published.

Cal. aurantiomurorum has only been reported on calcareous rocks in Sidi-Mecid near Azéba fort and in Djebel Akar Mts in Algeria (Flagey 1896: 28) and in Upper Galilee, Mt Carmel in Israel (Alon & Galun 1971: 287-288). *Cal. aurantiomurorum* was accepted in two lichen checklists of Israel (Galun & Mukhtar 1996: 152, Kondratyuk et al. 1996: 35), until the voucher material from Israel was redetermined as *Cal. flavescens* (Wasser & Nevo 2005: 100) and the name *Cal. aurantiomurorum* was excluded from the Israel lichen flora

(Wasser & Nevo 2005: 321) and erroneously put into the synonymy of *Cal. flavescens* (Wasser & Nevo 2005: 99).

The sample in H and parts of the samples in FH and PC belong to the lobate species of *Candelariella*. In southern Europe, three lobate species are known, *Can. medians*, *Can. rhodax*, and *Can. senior*. While the two former species are clearly different (Poelt & Vězda 1976, 1977), the latter fits well with the respective samples. The differences in the thallus thickness and spore width between the holotype specimen of *Can. senior* and the sample in H can be easily accounted for by intraspecific variation. Having seen more material of *Can. senior* from GZU, we consider them conspecific with the samples of the investigated exsiccatum. Previously, *Can. senior* was only known from the type locality in Spain (Poelt 1958: 440-441), and from Libya (Thor, unpublished data) and Tunisia (cf. Seaward 1996: 123) so far.

Other samples of *Can. senior* seen: **Algeria**. on limestone in “d’Azeba” (GZU, intermixed in sample Flagey: Lich. Alg. Exsic. 93, *Rinodina subconfragosa*). **Libya**. On calcareous stone near Derna (Darnah), Thor, 1982 (GZU). **Tunisia**. Douggha, Poelt, 1968 (GZU); Jebel Goraa Mts, between Thibar and Teboursouk, Poelt, 1968 (GZU).

Conclusions

Flagey’s exsiccatum of *Placodium aurantiomurorum* is composed of heterogeneous material. The samples in FH, PC and UPS are taxonomically indistinguishable from *Cal. aurantia*, and the sample in M is indistinguishable from *Cal. saxicola*. The sample in UPS is selected here as the lectotype of *Placodium aurantiomurorum* and we propose to put the name *Cal. aurantiomurorum* into the synonymy of *Cal. aurantia*. We consider the sample of *Cal. aurantiomurorum* in H and the admixed lichens in samples from FH and PC conspecific with *Candelariella senior*, which is newly reported from Algeria.

In the light of this work, more attention should be given not only to examining distributed material of this particular exsiccatum in other herbaria, but also to appraising the homogeneity of exsiccata in general.

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***Oligoporus balsameus* – rare Eurasian species plus notes on some related taxa**

WJACHESLAV A. SPIRIN^{1*}, IVAN V. ZMITROVICH² & SOLOMON P. WASSER³

^{1*} *slava_spirin@mail.ru*

University of Humanities, 15 Fuchika Str., St. Petersburg, 192238, Russia

² *iv_zmitrovich@mail.ru*

Lab. of the Systematics and Geography of Fungi

Komarov Botanical Institute, Russian Academy of Sciences

2 Prof. Popov Str., St. Petersburg 197376, Russia

³ *spwasser@research.haifa.ac.il*

International Center for Cryptogamic Plants and Fungi

Institute of Evolution, University of Haifa

Mount Carmel, Haifa 31905, Israel

Abstract—*Oligoporus balsameus* is described and illustrated according to material from southern and northern parts of Eurasia, and its taxonomy is discussed. Two closely related species, *O. cerifluus* and *O. floriformis*, are also treated and compared with *O. balsameus*. Recently described *Antrodia* species, *A. bondartsevae* and *A. primaeva*, are combined into the genus *Pilatoporus*, which seems to be a more appropriate place for them. *Spongiporus rhodophilus* sp. nov., is a close relative of *S. undosus*, growing on dead basidiocarps of *Rhodofomes roseus* in old boreal forests and having shorter spores. *Oligoporus cerifluus* is reported as new to Russia.

Key words— polypore, taxonomy

Introduction

The genus *Oligoporus* unites most small-sized resupinate or pileate polypores causing a brown rot of wood. Taxonomy of this genus, as well as the numerous species included, is very difficult. Many species clearly have southern distribution; some of them are known in the boreal zone; however, mycologists are often puzzled by whether or not the same species occur in both the south and north. Such is the case with *Oligoporus balsameus* (Peck) Gilb. & Ryvarden. This species has thin flabelliform basidiocarps, and together with other pileate species of genus [i.e., *O. cerifluus* (Berk. & M.A. Curtis) Ryvarden & Gilb., *O. floriformis* (Quél.) Gilb. & Ryvarden, etc.], constitutes a very complicated species

complex. Since *Oligoporus balsameus* is poorly studied and rare everywhere, we describe it and some its relatives below, and also discuss the taxonomy of the *Oligoporus* genus complex.

Materials and methods

The microscopic characters of polypores were studied in the Karl Zeiss-amplival microscope. The chemical reagents used in the microscopic examination were 5% solution of potassium hydroxide (KOH), Melzer's reagent (IKI), and Cotton Blue (CB). Measurements were made with an immersion objective; a total of 30 spores from each specimen was measured. To present a variation of spore size, 5% of measurements were excluded from each end of the range and are given in parentheses. Type material and specimens are traced in the herbaria of the Institute of Evolution, University of Haifa (Haifa, Israel, HAI), Komarov Botanical Institute, Russian Academy of Sciences (St. Petersburg, Russia, LE), and Finnish Museum of Natural History (Helsinki, Finland, H).

Taxonomic descriptions

The *Oligoporus* generic complex

Here, we treat *Polyporus balsameus* as a member of the genus *Oligoporus*, which we consider as a separate genus that is not synonymous with the epithet *Postia*. Both *Oligoporus* and *Postia* are united under the older name *Postia*, for example, by Rajchenberg (1995), and Hansen & Knudsen (1997). The concept of two independent genera was first proposed by Erkkilä & Niemelä (1986) and Renvall (1992). Recent molecular data (Niemelä 2005, Niemelä et al. 2005) support more sophisticated division in this group of polypores, which may be presented as following:

- *Oligoporus* Bref. 1888 (type *Oligoporus farinosus* Bref. = *Polyporus rennyi* Berk. & Broome). This genus comprises primarily brown-rot monomitic polypores having ellipsoid or short-cylindrical spores. Many species have cystidia and are able to produce chlamydospores in culture (Stalpers 2000).

- *Postia* Fr. 1874 (type *Polyporus lacteus* Fr.) includes those species with cylindrical or allantoid basidiospores; chlamydospores and cystidia are often absent. Tramal hyphae are parallel and not agglutinated, sometimes very thick-walled and resembling the skeletal. Contextual hyphae bear characteristic finger-like refractive outgrowths; this feature is observed also in the *Tyromyces* species [e.g., *T. chioneus* (Fr.) P. Karst.], which may be the closest relative.

- *Rhodonia* Niemelä & K.H. Larss. 2005 (type *Polyporus placenta* Fr.). The genus was established as a result of recent molecular studies (Niemelä et al. 2005) showing *Postia placenta* (Fr.) M.J. Larsen & Lombard to be very distant

from the *Oligoporus-Postia* generic complex, and much closer to *Antrodia* P. Karst. The sole species, *Rhodonía placenta* (Fr.) Niemelä, K.-H. Larsson & Schigel, has strongly amyloid hyphae, varying from thin-walled to subsolid, and then resembling skeletal. Moreover, the microscopic mounts prepared in CB are filled by numerous oily droplets. This feature links *R. placenta* with *Antrodia infirma* Renvall & Niemelä, *A. sandaliae* Bernicchia & Ryvarden, and *O. rancidus* (Bres.) Gilb. & Ryvarden, which should be included in this genus later. The genus *Pilatoporus* Kotl. & Pouzar may be closely related to *Rhodonía*.

– *Spongiporus* Murrill 1905 (type *Polyporus leucospongia* Cooke & Harkn.). Three closely related species, *S. leucospongia* (Cooke & Harkn.) Murrill, *S. lowei* (Pilát) A. David, and *S. undosus* (Peck) A. David, belong here. They share tight hyphal structure composed of very thick-walled amyloid and agglutinated generative hyphae; the spores are allantoid or cylindrical. A gelatinous layer is often observed between tubes and subiculum. A new species, *Spongiporus rhodophilus* sp. nov., is included in this paper.

Oligoporus balsameus (Peck) Gilb. & Ryvarden, Mycotaxon 22: 364, 1985. FIG. 1

- = *Polyporus balsameus* Peck 1878.
- = *Microporus balsameus* (Peck) Kuntze 1898.
- = *Coriolus balsameus* (Peck) Murrill 1907.
- = *Tyromyces balsameus* (Peck) Murrill 1914.
- = *Spongiporus balsameus* (Peck) A. David 1980.
- = *Postia balsamea* (Peck) Jülich 1982.
- = *Polyporus crispellus* Peck 1885.
- = *Tyromyces cutifractus* Murrill 1912.
- = *Tyromyces kymatodes* Donk, 1933. an avowed nom. nov. for *Coriolus kymatodes* (Rostk.) Bourdot & Galzin 1925 sensu auct.
- = *Leptoporus alma-atensis* Pilát 1937.
- = *Polyporus basilaris* Overh. 1941.

Basidiocarps annual, pileate, flabelliform or fan-shaped, with narrowed or resupinate base, fusing together in imbricate groups, often with pleasant meadow-sweet odour when fresh. **Pilei** 0.5–5 cm long, 2–10 mm thick, dense, covered by a thin cuticle. **Upper surface** agglutinated, with rough radially oriented hairs and large indistinct zones, at first white or grayish with reddish tints, later dirty brown. **Margin** sharp, even or only slightly undulate or turning down when drying. **Context** 0.5–2 mm thick, whitish to pale cream, coriaceous, dense. **Tubes** 0.5–4 mm thick, fleshy and white to pale ochraceous in fresh condition, hard and brownish when dry, sometimes with indistinct vinaceous-brown stains; pores angular to lacerate, 5–7 per mm, with thin entire or slightly lacerate dissepiments.

Hyphal system monomitic. Contextual hyphae thick-walled, clamped, 6–10 µm wide, mostly unchanging but sometimes inflating and dissolving in KOH,

rarely with dichotomously branching protuberances 2–2.5 μm in diam having a very narrow (up to 1 μm) lumina. **Trama** subparallel, hyphae thin- to distinctly thick-walled (walls 0.5–2 μm thick), densely arranged, 2.5–4.5(5) μm wide, amyloid (reaction weak in most specimens, moderate to strong in specimen Spirin 2338). Crystals absent. **Leptocystidia** present, conical to bottle-shaped, thick-walled, 18–26 $\times$ 6–9 μm , nude or rarely apically encrusted by crystal crown. **Basidia** clavate, clearly constricted, four-spored, 14–24 $\times$ 4–6 μm . **Basidiospores** ellipsoid, often guttulate, (3.7)3.9–4.7(4.9) $\times$ (2.1)2.2–2.5(2.6) μm , inamyloid, slightly thick-walled, plasma cyanophilous. **Conidial state** known only in vitro (Stalpers 1978, 2000). **Type of rot:** brown.



Fig. 1. *Oligoporus balsameus* (Spirin 2338): section through tube dissepiment.
Scale bar = 10 μm .

Note—The identification of *O. balsameus* is often difficult. Domański et al. (1973) mentioned that *O. balsameus* is developing forms similar to *O. floriformis*. This latter differs from *O. balsameus* in having thin-walled, usually collapsing hyphae in tube trama, and narrowly ellipsoid spores 3.5–4.4 $\times$ 1.9–2.5 μm . Another relative, *O. cerifluus*, has robustly thick-walled hyphae and cylindrical, slightly curved spores with concave ventral side 3.8–5.2 $\times$ 2.1–2.7 μm . Both *O. cerifluus* and *O. floriformis* are acystidiate polypores.

The variability of *O. balsameus* proper has been discussed many times (see, for example, Donk 1933; Bondartsev 1953; Domański et al. 1973). The specimens from Israel as well as from Russia, Finland, and Ukraine match

the descriptions by both European and American mycologists (Kotlaba & Pouzar 1968, Domański et al. 1973, Gilbertson & Ryvarden 1987, Ryvarden & Gilbertson 1993, Niemelä et al. 2004; see also colour picture in Niemelä 2005). However, the contemporary concept of *O. balsameus* is very wide and, probably, encompasses more than one species. The best character for splitting of *Oligoporus balsameus* into separate species would be amyloid reaction of cystidia and hyphae (P. Vampola and Z. Pouzar, pers. comm.).

Niemelä et al. (2004) described a new species, *Postia balsamina* Niemelä & Y.C. Dai, which occurs in boreal forests and has mostly resupinate basidiocarps with large pores (3–4 per mm); the next year Niemelä et al. (2005) transferred it to the genus *Oligoporus*.

In a recent paper, Spirin & Shirokov (2002) note that, in the old spruce forests of European Russia, *O. balsameus* grows on dead basidiocarps of *Fomitopsis rosea* (Alb. & Schwein.) P. Karst. [= *Rhodofomes roseus* (Alb. & Schwein.) Kotl. & Pouzar]. After a more detailed study, we decided that we were dealing with a separate species, described below as *Spongiporus rhodophilus*.

SPECIMENS EXAMINED—*OLIGOPORUS BALSAMEUS*. ISRAEL. Zomet Ealakim viet Wyer Wacol: *Pinus pinea*, 07.I.2001, Wasser (HAI F 0082). RUSSIA. LENINGRAD REGION: Veps Forest. Res., *Picea abies*, VIII.1999, Zmitrovich (LE); NIZHNY NOVGOROD REGION: Sanki, *Quercus robur* and dead *Hymenochaete rubiginosa*, 7.VIII.2005, Spirin 2338 (H, dupl. in LE and W.S.); KRASNODAR REGION: Hosta, *Taxus*, X.1966, Vasilyeva (LE 27472, LE 27490, LE 27492). UKRAINE. VINNITSA REGION: Satanovskoye, *Pyrus* and *Picea abies*, 10–23.IX.1936, Bondartsev (LE 27483, LE 27484, LE 27485, LE 27486). FINLAND. UUSIMAA: Helsinki, Koskela Hospital Park, *Crataegus douglasii*, 06.X.1999, Niemelä 6669 (H).

— *OLIGOPORUS BALSAMINUS*. FINLAND. KITTILÄN LAPPI: Kolari, Äkäslompolo, *Picea abies*, 31.VIII.1999, Niemelä 6601 & Dai (holotype, H).

— *OLIGOPORUS CERIFLUUS*. RUSSIA. NIZHNY NOVGOROD REGION: Kilemarsky Nat. Res., *Picea abies* (old building) and *Abies sibirica*, 16–17.VIII.2004, Spirin 2114, 2166 (H); Neveyka, *Pinus sylvestris*, 26.VIII.2000, Spirin (LE 212294); Razino, *Picea abies*, 12.VIII.1995, Spirin (LE 212262 – as *O. folliculocystidiatus*). MORDOVIA: Mordovsky Nat. Res., *Picea abies*, 27.VIII.1937, Nikolaeva (LE 26385) (new to Russia).

— *OLIGOPORUS FLORIFORMIS*. RUSSIA. NIZHNY NOVGOROD REGION: Kilemarsky Nat. Res., *Picea abies*, 19.VIII.2004, Spirin 2231, 2238 (H).

The genus *Pilatoporus*

This genus described by Kotlaba & Pouzar (1990) represents a well-defined group of polypores, having annual cheesy-corky trimitic basidiocarps, cylindrical or fusiform spores, and causing a brown rot. Most of the species are tropical or subtropical (Kotlaba & Pouzar 1990, 1998); however, Vampola (1996) found *Pilatoporus ibericus* (Melo & Ryvarden) Kotl. & Pouzar to be widely distributed in temperate zones of Europe (see also Spirin & Zmitrovich 2003).

Renvall & Niemelä (1992) described a new boreal species *Antrodia primaeva*, and demonstrated that some links of this species with the *Fomitopsis iberica* complex (= the genus *Pilatoporus*) exist. However, these authors refrained from assigning this new species to *Pilatoporus*, mainly due to its resupinate growth and poorly pronounced trimitic structure.

Spirin (2002) described a new species *Antrodia bondartsevae*, which is closely related to *Pilatoporus* (especially *P. ibericus*) but which differs mostly by its small-sized fragile effused-reflexed basidiocarps and smaller spores. The hyphal structure of *A. bondartsevae* was also regarded as trimitic; however, skeletal hyphae are less abundant in *A. bondartsevae* (as well as *A. primaeva*) than in core *Antrodia* species and show a clear transition to sclerified thick-walled generative hyphae. The latter feature was stressed by Vampola (1996) as essential to the genus *Pilatoporus*. So, there are evident reasons to transfer both *Antrodia bondartsevae* and *A. primaeva* into *Pilatoporus*.

Pilatoporus bondartsevae (Spirin) Spirin comb. nova (Mycobank number: MB510248) – basionym: *Antrodia bondartsevae* Spirin, Mikol. Fitopat. 36: 33, 2002.

Pilatoporus primaevus (Renvall & Niemelä) Spirin comb. nova, (Mycobank number: MB510249) – basionym: *Antrodia primaeva* Renvall & Niemelä, Karstenia 32: 30, 1992.

SPECIMENS EXAMINED—*ANTRODIA BONDARTSEVAE*. RUSSIA. NIZHNY NOVGOROD REGION: Kilemarsky Nat. Res., *Tilia cordata*, 24.VIII.2000, Spirin (LE 209783, holotype); Razino, *T. cordata*, 5.VIII.1997, Spirin (LE 208446, paratype); Podvyezze, *T. cordata*, 30.VII.2005, Spirin 2306 (H, LE).

— *ANTRODIA PRIMAEOVA*. RUSSIA. NIZHNY NOVGOROD REGION: Razino, *Picea abies*, 09.VIII.2005, Spirin 2360 (H). FINLAND. SOMPION LAPPI: Savukoski, *Pinus sylvestris*, 19.IX.1988, Renvall 1372 & T. Renvall (H, holotype).

— *PILATOPORUS IBERICUS*. IRAN. Mazandaran, Chalus, *Alnus*, 09.VIII.1972, Kukkonen 7858 (H).

Spongiporus rhodophilus Spirin & Zmitr. sp. nov.

FIGS. 2-3

(Mycobank number: MB510247)

Basidiomata annua, pileata, basi angusto adnata, imbricata, carnosio-coriacea in vivo, tactu rubescenti brunnea, coriacea et dura in statu sicco. Pilei undulati, flabelliformi, tenui, 0.5–3 × 0.4–2.5 × 0.1–0.3 cm, superficies concentrice-zonata, rubella, indistincte radialiter-fibrillosa, cuticula tenui tecta. Margo acutatus, subtus fertilis. Contextum 0.5–1 mm crassum, album vel pallide-coloratum, coriaceo-fibrillosum. Tubulis ad 2 mm crassis, translucetibus. Poris rotundo-angularibus, 4–6 per mm. Systema hypharum monomiticum. Hyphae generativae fibulatae, ramosae, in subhymenio tenuitunicatae (tunicae ad 1 µm crassae), ad 4 µm latae, in contexto crassitunicatae, ad 8 µm latae. Leptocystidia adsunt, 15–32 × 4–5 µm. Basidia clavata, 14–28 × 4–4.5 µm. Sporae brevicylindricae, biguttulatae, curvae, 3.6–4.8 × 1.7–2.1 µm, inamyloideae. Ad truncis dejectos Piceae abietis et carpophora mortua Rhodofomitis rosei.

Etymology: from the Latin *Rhodofomes* = genus of host fungus.



Fig. 2. *Spongiporus rhodophilus* (specimen Spirin 2247): basidiocarps. Scale bar = 1 cm.
Photographed in situ by A. Shirokov.

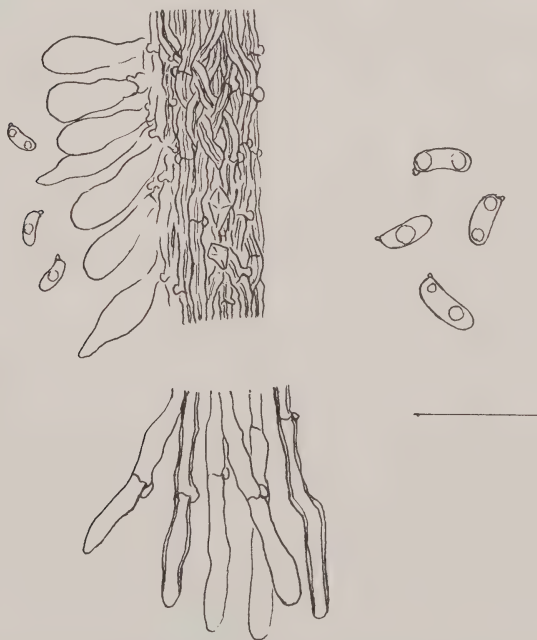


Fig. 3. *Spongiporus rhodophilus* (holotype): hymenium (above left), hyphae of dissepiment edge (below left), and spores (right). Scale bar = 10 μ m.

Basidiocarps annual, pileate-flabelliform, often with narrowed base, mostly in imbricate groups, rarely effused-reflexed, with reddish brown stains when bruised. **Pilei** 0.4–2.5 cm long, 1–3 mm thick, dense, undulate, covered by a thin cuticle. **Upper surface** slightly agglued, with small radially orientated hairs and frequent distinct zones, firstly pure white to pale yellow with reddish tints, later with distinct brownish hue, especially at the margin. **Margin** sharp, strongly undulate, distinctly turning down during drying. **Context** 0.5–1 mm thick, creamish to brownish, radially fibrillose, dense, often with brownish gelatinous band. **Tubes** 0.5–2 mm thick, firstly pure white, then dirty gray with clear reddish tints, fleshy-coriaceous and agglutinated in fresh condition, very hard when dry; pores angular to lacerate, (3)4–5 per mm, with thin entire or slightly dentate dissepiments.

Hyphal system monomitic. Contextual hyphae thick-walled, clamped, 4–8 μm wide, with dichotomously branching protuberances 2–3 μm in diam, having a very narrow lumina (up to 1 μm). **Trama** subparallel, hyphae thin- to moderately thick-walled (walls 0.5–1 μm thick), densely arranged, 2.5–4 μm wide, amyloid; some of them having yellowish oily content. **Leptocystidia** present, bottle-shaped, thin-walled, sometimes with clear medial constriction, 15–32 $\times$ 4–5 μm . **Basidia** long-clavate, clearly constricted, four-spored, 14–28 $\times$ 4–4.5 μm . **Basidiospores** short-cylindrical, often guttulate, slightly bent when mature, (3.4)3.6–4.8(5.1) $\times$ (1.6)1.7–2.1(2.2) μm , inamyloid, plasma cyanophilous. **Conidial state** not found. **Type of rot**: not known certainly, presumably brown.

HOLOTYPE, ISOTYPE AND PARATYPES—RUSSIA. NIZHNY NOVGOROD REGION: Kilemarsky Nat. Res., dead basidiocarps of *Rhodofomes roseus* grown on *Picea abies*, 24.VIII.2000, Spirin (*H* – holotype, isotype LE 211354). — *ibid.*, *Rhodofomes roseus* and *Picea abies*, 24.VIII.2000, 16–20.VIII.2004, Spirin 2098, 2247, 2248, 2255, 2263 (LE 211352, isoparatypes in *H* and *HAI*); Belbazzh, *Picea abies* and dead basidiocarps of *Rh. roseus*, 27.VIII.2000, Spirin (LE 211343).

Ecology—On dead basidiocarps of *Rhodofomes roseus* and on wood of *Picea abies* in old spruce ('southern taiga' – Spirin & Shirokov 2002) forests.

Note—The species is easily identified by its medium-sized strongly undulate basidiocarps, relatively narrow spores, and peculiar ecological preferences. Its closest relative is evidently *Spongiporus undosus*, which differs by distinctly narrower and longer spores (ca. 4.5–6.1 $\times$ 1.1–1.6 μm), and less dense hymenial tissue. *Spongiporus lowei* is almost resupinate, fragile, and its spores are straight (not curved), ca. 4.1–5.3 $\times$ 1.7–2.2 μm . The species of the *Oligoporus floriformis* complex, having flabelliform or fan-shaped basidiocarps (e.g., *O. floriformis* and *O. cerifluus*), are characterized by more fragile fibrillose fruitbodies and a presence of conidial state on pileal surface. They often grow on wood of conifers too, but without any association with other polypores.

ADDITIONAL SPECIMENS EXAMINED—*SPONGIPORUS UNDOSUS*. RUSSIA. NIZHNY NOVGOROD REGION: Kilemarsky Nat. Res., *Picea abies*, 16.VIII.2004, Spirin 2278 (H); Razino, *P. abies*, 5.VIII.1998, Spirin (LE 211351), *Populus tremula*, 14.VIII.2006, Spirin 2522 (H); Kurley, *Quercus robur*, 14.VIII.2005, Spirin 2422 (H).

– *SPONGIPORUS LOWEI*. FINLAND. ETELÄ-HÄME: Vesijako, *Pinus sylvestris*, 5.X.1985, Niemelä 3304 (H).

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Variability of *Byssomerulius corium* in the Mediterranean

IVAN V. ZMITROVICH^{1*}, WJACHESLAV A. SPIRIN² & SOLOMON P. WASSER³

^{1*} iv_zmitrovich@mail.ru

Lab. of the Systematics and Geography of Fungi
Komarov Botanical Institute, Russian Academy of Sciences
2 Prof. Popov Str., St. Petersburg 197376, Russia

² slava_spirin@mail.ru

University of Humanities, 15 Fuchika Str., St. Petersburg, 192238, Russia

³ spwasser@research.haifa.ac.il

International Center for Cryptogamic Plants and Fungi
Institute of Evolution, University of Haifa
Mount Carmel, Haifa 31905, Israel

Abstract—The variability of the common corticioid *Byssomerulius corium* is discussed. Emended descriptions of both species and genus *Byssomerulius* are provided and a xerophilous variety (*B. corium* var. *halileensis*, growing on *Quercus calliprinos* wood in a sub-arid region of the East Mediterranean in Israel) is proposed. Basidiocarps representing the new variety can be diagnosed by their almost smooth or minutely folded hymenium. *B. corium* var. *halileensis* greatly resembles the species *B. armeniacus*, in need of further study.

Key words—xerophilous variety, *Byssomerulius corium* var. *halileensis*

Introduction

The merulioid fungus *Thelephora corium* was described by Persoon in his “Synopsis methodica fungorum” (Persoon 1801), and this name was sanctioned by Fries (1821). Following Fries (1828), most mycologists have placed this fungus in the genus *Merulius*. Because of its variability, the species was redescribed under various names during the 19th and 20th centuries, and its generic position oscillated among *Cladoderris*, *Phlebia*, or *Merulius*.

When Parmasto (1967) established the new genus *Byssomerulius*, he designated *Merulius corium* as type and introduced new combinations for *Merulius ceracellus* Berk. & M.A. Curtis, *M. farlowii* Burt, *M. serpens* Tode: Fr., *M. hirtellus* Burt, and *M. rubicundus* Litsch. At the same time, he described *Byssomerulius armeniacus* as a new species. In its original circumscription, the genus in question was artificial, since it included the species with waxy

and wrinkled hymenophoral strata and byssoid abhymenial surfaces. Later, it became obvious that *Merulius ceracellus* and *M. farlowii* were synonyms for *Merulius serpens* (Ginns 1976), a member of *Lilaceophlebia* (Spirin & Zmitrovich 2004).

As presently circumscribed, the genus *Byssomerulius* includes *B. corium*, *B. hirtellus*, and *B. albostramineus* (Torrend) Hjortstam (= *B. rubicundus*) as core species that are grouped with a set of recently added taxa characterized by a non-meruloid hymenium (e.g., *Odontia pirottiae* Bres., *Phanerochaete joseferreirae* (D.A. Reid) D.A. Reid, *Ph. avellanea* (Bres.) J. Erikss. & Hjortstam; – see Zmitrovich 2001 and Spirin & Zmitrovich 2004 for a complete list). Despite this, *B. corium* still remains a conglomerate that continues to offer many surprises for taxonomists.

The present paper considers some materials collected from subarid areas of the Mediterranean, Caucasus, and southern Russia where *B. corium* occurs.

Materials and methods

Most native material was collected in Upper Galilee (Israel) from *Quercus calliprinos* branches. All samples are preserved in the herbarium of the Institute of Evolution (Haifa, Israel). Holotypes and exsiccates kept in Komarov Botanical Institute (St. Petersburg, Russia, LE) were also studied.

The microscopic characters of meruloid fungi were observed with Karl Zeiss-amplival microscope. Chemical reagents used in the microscopic examinations were 5% solution of potassium hydroxide (KOH), Melzer's reagent (IKI) and Cotton Blue (CB). Measurements were made under oil immersion; 30 spores from each specimen were measured. Spore ranges were calculated excluding the high and low 5% of measurements.

Discussion

Variable morphological characteristics of *Byssomerulius corium*

The fungus forms resupinate basidiocarps as dorsally attached (usually merging) pilei or totally prostrate crusts with wrinkled ceraceous hymenium of cream, pale, or ochraceous colors. However, in a young state the hymenium can be smooth or the folds poorly pronounced.

Microscopically, the basidiocarp is composed of efibulate hyphae, ramified at sharp or almost right angles; hyphae are thin-walled and densely packed in subhymenium, with thickened walls in trama, and thick-walled in abhymenial layer. The hyphal system can thus be characterized by the term “pseudodimitic”, like that of *Schizophyllum commune* Fr.: Fr. (Zmitrovich et al. 2004). In resupinate forms, the hyphae of the medullar tissue and abhymenial stratum

are loosely interwoven and form a trichodermoid palisade on the pileus. In older basidiocarps many encrusted hyphae can be observed within all tissues.

The basidia are of meruloid type, i.e. with a definitely expressed medial constriction, located in small clusters. It is interesting that mature basidia are sometimes 1.5–2 times longer than young ones.

Cystidia are not characteristic of the species, but basidioles occasionally protrude cystidia-like from the hymenium as fusoid or capitate structures. Although reported earlier only for '*B. hirtellus*,' this phenomenon was frequently observed by us in *B. corium* (cf. Ginns 1976).

Basidiospores show considerable variation in *B. corium*. Cylindrical spores with certain suprahilar depression ($5\text{--}7 \times 2\text{--}3.5 \mu\text{m}$) represent the 'average' morphotype. However, spores can be shorter or longer with an outline slightly amygdaloid or sigmoid, depending on basidiocarp age and microhabitats.

Short-spored specimens have, as a rule, hymenia that are smooth (or nearly so) and completely prostrate basidiocarps. Due to low humidity, specimens develop in exposed microhabitats (e.g., on dead branches). As shown by comparative analysis of basidiospore variability (see table), there is a certain overlapping between such xerophilous forms of *B. corium* and *B. armeniacus* (the latter described by Parmasto as an independent species, and later regarded as a synonym of *B. hirtellus*) (Ginns 1976). The authenticity of these taxa deserves much closer study, especially when using mating and molecular methods.

Taxonomic descriptions

Byssomerulius Parmasto, Eesti NSV Tead. Akad. Toim. Biol. 16: 383, 1967.

Basidiocarps wood-inhabiting or lichenized, meruloid (infundibuliform to resupinate) or corticioid; **hymenophore** folded, raduloid, tuberculate to even, of ceraceous consistence; **trama** irregular to subregular; **context** wadded, rather dense; **hyphal system** pseudodimitic; **hyphae** simple septate or with rare double clamp-connections, thin- to thick-walled, regularly branched at a sharp angle; contextual hyphae uninflated, not exceeding epibasidial segment in width; **cystidia** none; **basidia** long clavate, constricted, thin-walled at the bases, 4-spored; **basidiospores** cylindrical, slightly curved (of suballantoid or sigmoid appearance), in some cases amygdaliform, thin-walled, neither amyloid, nor dextrinoid, acyanophilous. **Type of rot**: white.

GENUS TYPE—*Thelephora corium* ($\equiv$ *Byssomerulius corium*). [Refer to Spirin & Zmitrovich (2004) and Zmitrovich et al. (2006) for more details regarding the changing concepts of *Byssomerulius* and *Meruliopsis* after Parmasto (1967).]

Byssomerulius corium (Pers.: Fr.) Parmasto, Eesti NSV Tead. Akad. Toimet. Biol.

16: 383, 1967.

FIG. 1

= *Thelephora corium* Pers.: Fr. 1821.

= *Merulius corium* (Pers.: Fr.) Fr. 1828.

= *Meruliopsis corium* (Pers.: Fr.) Ginns 1976.

= *Merulius confluentis* Schwein.: Fr. 1822.

= *Merulius pallens* Schwein. 1832, non Berk. 1841.

= *Merulius aurantiacus* Klotzsch ex Berk. 1836, non (Wulfen: Fr.) J.F. Gmel. 1792.

= *Merulius haedinius* Berk. & M.A. Curtis 1872.

= *Merulius sordidus* Berk. & M.A. Curtis ex Cooke 1891.

= *Merulius pelliculosus* Cooke 1891.

= *Phlebia deglubens* Berk. & M.A. Curtis ex Cooke 1891.

= *Merulius deglubens* (Berk. & M.A. Curtis ex Cooke) Burt 1917.

= *Phlebia sodiroi* Pat. 1892.

= *Merulius sodiroi* (Pat.) Rick 1960.

= *Merulius moelleri* Bres. & Henn. 1896.

= *Merulius stereoides* Henn. 1901.

= *Merulius ulmi* Peck 1906.

= *Merulius hirsutus* Burt 1917.

= *Merulius cubensis* Burt 1917.

= *Merulius flavescens* Bres. 1920.

= *Merulius ochraceus* Lloyd 1921.

= *Merulius aurantius* Lloyd 1922.

= *Cladoderris rickii* Lloyd 1923.

= *Merulius chilensis* Speg. 1924.

= *Merulius dubiosus* Bres. ex Rick 1938.

Basidiocarps annual or persisting, resupinate – prostrate or pileate, 5–10 × 2–4 × 0.5–6 mm, usually confluent, papery, fragile when dry. Abhymenial surface tomentose to almost glabrous, obscurely zonate, white to grayish. **Context** white, suberose. **Margin** up to 3 mm wide, sterile, white, inrolled or adhered to the substrate. **Hymenium** 0.2–2 mm thick, folded (meruloid), creamish, yellowish, pale, reddish, or pale-ochraceous, with some grayish or violaceous tints in old basidiocarps, of ceraceous consistency.

Hyphal system pseudodimitic. **Hyphae** 2–6(8.5) μm in diam., simple septate or with rare double clamp-connections, thin- to slightly thick-walled, regularly branched at a sharp angle, sparsely encrusted. **Cystidia** none, but with basidioles having in some cases hyphoid or capitate apical proliferation. Basidia long-clavate, constricted, 17–40 × 4–6 μm , 4-spored, simple-septate at base. Spores ellipsoid-cylindrical, with suprahilar depression, in some cases, slightly curved, 4.5–9 × 2.3–4.5 μm , smooth, thin-walled, hyaline, usually with a central oil-drop, inamyloid, slightly cyanophilous when young.

Ecology, range, and distribution—Grows on dry, fallen branches and trunks of leafy trees. Produces a white rot. Found in Europe, Asia, Africa, Australia; North, Central, and South America. The species is widely distributed over the



Fig. 1. *Byssomerulius corium* var. *corium* (HAI F0083)
Basidiocarps. Scale bar = 1 cm.

Northern Hemisphere, but distinctly more frequent in subarid areas. In the taiga forests *B. corium* prefers intra-zonal elements of the vegetation cover. The most typical substrate for the species is dry, attached elm branches, but the fungus occurs also on linden, oak, maple, willow, alder, rowan, birch, aspen, plus many subtropical trees and shrubs.

Note—Despite its great variability, *B. corium* is easily distinguished due to characteristic parchment basidiocarps and ceraceous merulioid hymenium with pale ochraceous tints. Sometimes the hymenial folds look like small dummies, and, in some cases, the hymenium has an irpicoid appearance.

These forms were reported by Corner (1971) for the paleotropics, but in 1993 an irpicoid specimen was found in St. Petersburg (northwest Russia). The coloration of the hymenium varies considerably, but an ochraceous-pinkish tint remains rather constant. In some cases, prostrate forms of *B. corium* can be confused with *Lilaceophlebia serpens* (Tode: Fr.) Spirin & Zmitr., which usually differs in having a rather brightly colored hymenium with more or less expressed olive hues.

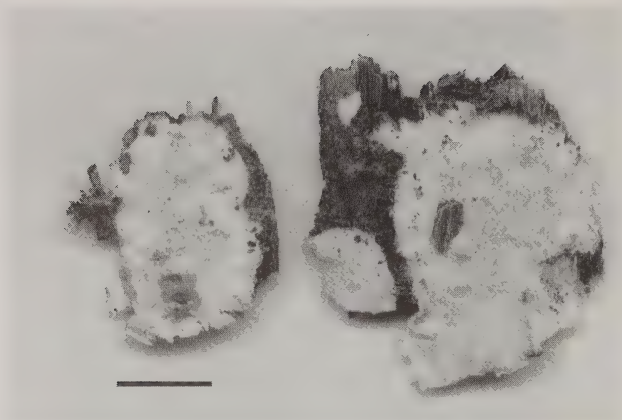


Fig. 2. *Byssomerulius corium* var. *halileensis* (HAI F0084)
Basidiocarps. Scale bar = 0.5 cm.



Fig. 3. *Byssomerulius corium* var. *halileensis* (HAI F0084):
Section through hymenial fold; spores. Scale bar = 10 μ m.

Table 1. Spore variability of some xerophilous forms of *Byssomerulius corium* and *B. armeniacus*

Species Specimen No.	Spore dimensions (range in μm)	Mean spore length	Mean spore width	Mean spore quotient (Q)
<i>B. corium</i> HAI F0083	5.0–9.0 $\times$ 2.5–3.5	7.15	2.95	2.42
<i>B. corium</i> HAI F0084	4.5–7.5 $\times$ 2.3–2.8	5.5	2.56	2.14
<i>B. corium</i> HAI F0085	5.0–7.1 $\times$ 2.3–2.6	5.6	2.5	2.24
<i>B. corium</i> HAI F0086	5.0–7.5 $\times$ 2.4–4	5.3	3.2	1.67
<i>B. armeniacus</i> TAA 16280	3.8–5.2 $\times$ 2.1–2.8	4.5	2.45	1.84

Byssomerulius corium var. *halileensis* Zmitr., Spirin & Wasser var. nov. FIGS. 2, 3
(Mycobank number: MB510250)

A typo hymeniiis cremeis sublaevesceque et sporis minutis discrepat.

Etymology: from the Latin *Halilea* (= Galilee), a district in Israel.

ORIGINAL MATERIAL: ISRAEL. Upper Galilee, *Quercus calliprinos* forest, on trunk of *Quercus calliprinos*, 19.III.2004, leg. & det. I.V. Zmitrovich (Holotype HAI F0084).

Basidiocarps 3–15 cm in diam, 0.1–0.8 mm thick, prostrate or slightly pileate (pilei up to 5 cm wide) sometimes cordonic, pale cream. **Hymenium** smooth or minutely folded, pale-cream, almost concolorous with the margin. Hyphae 2–6(18) μm in diam, densely packed in subiculum, moderately or strongly encrusted by amorphous matter. **Cystidia** none. **Basidioles** cylindrical to fusoid, 25–60 $\times$ 4–5 μm , enclosed or protruding the hymenium. **Basidia** 15–25 $\times$ 4–6 μm , 4-spored. Spores mostly short-cylindrical, 4.5–7.5 $\times$ 2.3–2.8 μm .

B. corium var. *halileensis* differs from the type variety by its creamy smooth to minutely wrinkled hymenium and the predominance of shorter spores. Spore measurements are the main means for distinguishing this variety from *B. armeniacus* (see table). Some other differences can be added, too. First, both *B. armeniacus* and *B. hirtellus* have no incrustation on their subhymenial and subicular hyphae. Second, the spores of *B. armeniacus* are less variable in their length (mostly not exceeding 5 μm long), while they are constantly longer and often varying in their size in *B. corium* var. *halileensis*. Moreover, subicular hyphae of *B. armeniacus* have slightly thickened walls, in contrast to clearly thick-walled hyphae of *B. corium* var. *halileensis*. So, we are inclined to address this xerophilous taxon to *B. corium* rather than to *B. armeniacus*.

ADDITIONAL SPECIMENS EXAMINED—*BYSSOMERULIUS CORIUM*. ISRAEL. Upper Galilee, *Quercus calliprinos* forest, on trunks and branches of *Quercus calliprinos*, 19.III.2004, I.V. Zmitrovich (HAI F0083, HAI F0084, HAI F0085, HAI F0086). REPUBLIC OF SOUTH AFRICA. WESTERN CAPE PROVINCE: Stellenbosch, J. Marias nature reserve, on bark of *Quercus suber*, 25.II.2002, V.A. Melnik (LE 211995). AUSTRIA. Ex Hoehnel Kryptogamae exsiccatae No 1142, *Aesculus rubicundus*, F. Hoehnel. ESTONIA. Ex Fungi Estonici Exsiccati, Fasc. I No 13, Tartumaa, *Tilia cordata*, 20.VI.1930, leg. E. Lepik, det. V. Litschauer. U.S.A. Ex Ravenel's Fungi Americani Exsiccati No 136, Florida, Nyssa, S. Car. SWEDEN. Ex Lundell & Nannfeldt's Fungi Exsiccati Suecici, on dead, fallen branches and trunks of *Populus tremula* and *Salix* sp., 18.X.1932, S. Lundell. ITALIA. Ex Erb. Crit. Ital. Ser. II. 'Sui pali deglisteccati che fiacheggiano I vitali del giardino del cisternone a Livorno', XI.1872, G. Arcangeli. RUSSIA. Griby Minusinskoi Flory, Minusinsk, on fallen *Betula* sp., A. Martianoff (LE 166059).

—*BYSSOMERULIUS ARMENIACUS*. ARMENIA. Kaphan, Tsav, *Sambucus ebulus*, 2.X.1962, E. Parmasto (TAA 16280).

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Thallus development and the systematics of Chytridiomycota: an additional developmental pattern represented by *Podochytrium*

WILL H. BLACKWELL, PETER M. LETCHER & MARTHA J. POWELL*

*mpowell@biology.as.ua.edu

Department of Biological Sciences, The University of Alabama
Tuscaloosa, AL 35487 USA

Abstract—Use of thallus developmental patterns in the systematics of chytridiomycetous fungi has been controversial, especially regarding the taxonomic rank or level at which use is appropriate. This review analyzes and interprets developmental thallus morphology among a spectrum of Chytridiomycota. Investigation of this topic revealed an additional mode of development, represented by the genus *Podochytrium*, distinct from developmental patterns previously recognized. Some genera that may seem morphologically comparable based on the mature thallus may in fact attain this morphology by different patterns of development. Although thallus development is of questionable macrosystematic and phylogenetic utility among chytrids because of convergence, patterns of thallus development can nonetheless be helpful in distinguishing one chytrid genus from another.

Key words—apophysis, bipolar growth, prosperangium, sporangium, zoospore cyst

Introduction and historical overview

Traditionally, two main, somewhat opposing viewpoints have expressed the optimal means of delimiting major systematic groupings (orders, families, subfamilies) of Chytridiomycetes (especially among eucarpic, monocentric taxa)—that of F. K. Sparrow and of A. J. Whiffen. Sparrow (1933a, p. 63) commented that “the operculum [of the sporangium] impresses one as a morphological structure of some significance.” Sparrow (1942, 1943) subsequently emphasized use of sporangial operculation versus inoperculation in delimiting major groupings of chytrids; a similar, if preliminary, view was presented in outline form by Gäumann & Dodge (1928). Secondly, Sparrow (1943) emphasized habit in classification, i.e., whether the sporangium occurred extramatrically (epibiotic or interbiotic sporangia) or intramatrically (endobiotic sporangia). By comparison, Whiffen (1944) emphasized differences in thallus development for broad systematic purposes in chytrids. Of primary

importance in Whiffen's system is whether the sporangium develops directly from the zoospore cyst or from a portion of the germ tube of the zoospore cyst, a distinction Petersen (1910) briefly noted. Whiffen (1944) did not consider the presence or absence of operculation significant in chytrid macrosystematics; Haskins & Weston (1950) likewise questioned the taxonomic value of operculation. Both Sparrow and Whiffen gave credence, though not identical importance in the general classification of chytrids, to whether the thallus was monocentric or polycentric. In any case, the classifications by Sparrow and Whiffen are not substantially congruent. Sparrow (1943, 1960) recognized three families of eucarpic, monocentric chytrids in *Chytridiales* and two families (three if including the variable *Physodermataceae*) of polycentric members of this order. Whiffen (1944) recognized just two families of eucarpic, monocentric chytrids in *Chytridiales* and only one polycentric family. Karling's (1932) early emphasis on holocarpic versus eucarpic thalli found some consistency of application at the family level, e.g., the *Olpidiaceae* (Sparrow 1960).

Roane & Paterson (1974) supported Whiffen's (1944) viewpoint on the importance of thallus development, expanding on Whiffen's system. Barr (1978) likewise felt that thallus development was more significant than operculation in the systematic delimitation of major groupings of chytrids. However, Barr (1978) placed primary emphasis on whether the nucleus of the zoospore cyst remains within the cyst or migrates into the zoospore germ tube during thallus development. Longcore (2002) pointed out, as demonstrated by Powell & Koch (1977), that migration of the cyst nucleus into the germ tube allows a chytrid to establish zoosporangia endobiotically or intramatrically (i.e., within the substrate); such a migration is thus a feature of biological significance. Barr (1978) in fact viewed such endobiotic chytrids, generally, as derived compared with epibiotic chytrids. Both Barr (1990) and Longcore (2002) used the terms "endogenous" (meaning, zoospore nucleus remaining in the cyst) and "exogenous" (meaning, zoospore nucleus migrating out of the cyst, into the germ tube) in this new context. A problem with this terminology is the possible confusion with older usage of the same terms for general thallus development (Karling 1936, 1977; Sparrow 1943, 1960; Hanson 1946). In traditional usage "exogenous" is equivalent to "extramatricial" (epibiotic or interbiotic) sporangial position, and "endogenous" is equivalent to "intramatricial" (endobiotic) sporangial position. In the common genus *Rhizophyidium*, for example, one encounters the apparent contradiction that thallus development is "exogenous," when speaking of sporangial position, but "endogenous" when speaking of the zoospore cyst nucleus (i.e., that the nucleus is retained within the cyst).

Determining whether the zoospore cyst nucleus migrates or not (Powell & Koch 1977, Barr 1978, 1990; Longcore 2002) is crucial to understanding

differences in thallus development. To solve the semantic problem, concerning movement of the cyst nucleus, it is simpler to speak of “non-migratory” in place of “endogenous” (i.e., nucleus retained in the cyst), and “migratory” in place of “exogenous” (i.e., nucleus moves out of the cyst). In the latter case, nuclear migration is usually from the zoospore cyst into the germ tube, as would be understood from Barr and Longcore. However, a different migration of the cyst nucleus may occur. If the zoospore cyst functions as, or develops into, a prosperangium, migration of the nucleus may be into the sporangium from the prosperangium, as in *Polyphagus*. “Prosperangial migration” is important in *Podochytrium* development, as will be seen under our discussion of that developmental type. Thus, replacement terminology (“migratory” and “non-migratory”), regarding the destination of the zoospore cyst nucleus, allows retention of “exogenous” and “endogenous” in original context—i.e., location of sporangial thallus, apophysis, resting spore, etc., relative to the substrate—important, particularly, in describing the unusual progression of development in *Chytridium lagenaria*.

One may extrapolate from Barr (1980) that both traditional points of view (Sparrow 1943, emphasizing operculation; and Whiffen 1944, emphasizing thallus development) have had relevance, and some consistency of application, in delimiting major groupings of chytrids. As Barr suggested, however, these traditional approaches have not provided entirely satisfactory or even mutually compatible, systematic answers. Accordingly, Barr (1980, 1990, 2001) increasingly emphasized zoospore type and fine structure for improved systematic understanding of Chytridiomycota (Longcore 2002, Letcher & Powell 2005). Barr's (1980) delineation of chytrid groupings, based fundamentally on zoospore ultrastructure, derived a classification in which a new order of Chytridiomycota—the *Spizellomycetales*—was recognized. Blackwell et al. (2004) discussed differing points of view on chytrid systematics, concluding that, whereas ultrastructural features of the zoospore are essential as a primary suite of characters in chytrid systematics, arguments can still be made for taxonomic use of both operculation and thallus development. However as Blackwell et al. (2004) indicated, both classical and modern features employed in chytrid systematics are best used in consort, not competitively. A collaborative approach, though, implies detailed assessment of the taxonomic level or levels at which different kinds of taxonomic characters, or suites of characters, are most meaningfully brought to bear. The applicability of traditional features of thallus morphology and thallus development among chytrids now appears to be significant mainly at lower levels of classification (genus, species), and not primarily in deciphering higher ranks or categories (orders, families); this viewpoint is also supported in recent molecular systematic studies (Letcher et al. 2005) and is explained in our Discussion.

Although variation and taxonomic significance of operculation should be thoroughly reinvestigated, the focus of our present paper is thallus development. We pursue this focus because the additional developmental type we recognize is represented in *Podochytrium*, a genus containing only inoperculate species. Thus, herein we consider primarily how insights from examination of thallus development (sensu Whiffen 1944, Roane & Paterson 1974, Barr 1978) may refine the concept of *Podochytrium* and similar genera of Chytridiomycota. This evaluation is best accomplished in the context of a review of known chytrid thallus types to strengthen understanding of thallus development. It will be important to see how improved knowledge of thallus development will interface with the emerging resolution that molecular analyses bring to chytrid phylogeny (James et al. 2000, Letcher & Powell 2005, Letcher et al. 2004, 2005), particularly as these analyses become refined at the generic and specific levels.

Thallus developmental types in Chytridiomycota

In ascribing systematic significance in Chytridiomycetes to thallus development, Whiffen (1944) outlined five basic types of development among monocentric, eucarpic members of the *Chytridiales* (types #1–#5, listed below). A sixth type of development may be surmised (cf. Sparrow 1943; Whiffen 1944) if the category “polycentric” is included (type #6). Whiffen’s monocentric developmental patterns were reviewed by Roane & Paterson (1974), who added a putative additional type of monocentric development (type #7). We here recognize yet another monocentric mode of thallus development, exemplified by the development of *Podochytrium* (type #8). Since we are suggesting this “*Podochytrium* pattern” as an additional developmental type among chytrids, substantial detail is provided for this pattern. Since the developmental pattern suggested by Roane & Paterson (type #7), as well as precisely which chytrid taxa exhibit this pattern, are controversial, considerable attention is devoted to this category as well. And, because of its peculiar nature, some extra explanation is also due type #3. For comparability, descriptions, examples, and illustrations are provided for the eight types of chytrid thallus development recognized (Figs. 1–8).

Whiffen’s (1944) five developmental patterns in monocentric chytrids

The developmental patterns that Whiffen (1944) recognized are here annotated, expanded, and updated (with respect to information in Karling 1977, Barr 1990, 2001; Longcore 2002 among other references, and based also on our own observations). Examples provided—some additional to those in previous references—are mainly from eucarpic chytrids; but holocarpic examples (e.g., *Olpidium*) are also included, since similar developmental patterns occur. The patterns listed below are not iron-clad for specific taxa. For example, the

well-known, typically interbiotic (extramatrix) genus *Rhizophlyctis*, usually exhibiting a monocentric thallus (and fitting under type #1), may rarely develop in the manner of type #4 (e.g., *Entophlyctis*), or of type #6 (e.g., *Nowakowskiella*), cf. Karling (1947). Also, certain species of *Entophlyctis*, though consistently intramatrix and typically conforming to type #4, may occasionally exhibit thallus development reminiscent of *Rhizophlyctis* (type #1), cf. Powell & Koch (1977). The patterns outlined are thus generalizations, representing the typical situation for the patterns and organisms listed.

Type #1. The encysted zoospore enlarges directly into the sporangium, the cyst nucleus being non-migratory. The sporangial thallus is either epibiotic (*Rhizophydium*, and *Phlyctidium* if considered distinct from *Rhizophydium*) or interbiotic (*Rhizidium* and, typically, *Rhizophlyctis*). This mode of development has been generally construed to be the simplest, most direct, and possibly the most primitive type of development among Chytridiomycota (cf. Barr 1978)

Figure 1

Type #2. The encysted zoospore enlarges, sometimes also becoming altered in shape, to form a prosporangium, from which the sporangium develops. The zoospore cyst nucleus is migratory, from prosporangium to sporangium, this migration occurring after prosporangial expansion. The sporangial thallus is typically interbiotic, only the rhizoid tips being endobiotic; e.g., *Polyphagus*, *Endocoenobium*, *Sporophlyctis*.

Figure 2

Type #3. An intramatrix swelling of the germ tube enlarges into a relatively large apophysis which functions as a prosporangium, contributing to subsequent extramatrix development of the encysted zoospore into the sporangium. Before significant sporangial expansion, the zoospore cyst nucleus (or one of its immediate division products) may migrate through the penetration tube into the incipient apophysis, resulting in apophyseal expansion. This (migrated) nucleus, or its progeny, can migrate back into the zoospore cyst, leading to further sporangial development. This combined, or at first alternating, mode of development corresponds to Karling's (1936) description of "endo-exogenous" thallus development in *Chytridium lagenaria*. The developing (intramatrix, i.e., endogenous) apophysis is often, for a time at least, larger than the developing (extramatrix, i.e., exogenous) sporangium. Rather than always contributing to sporangial generation, the apophysis may develop as a resting spore. In some

Note on illustrations on pp. 96, 98, & 103: The eight sets of Figures correspond, in order, to the eight (numbered) types of sporangial development, from the zoospore cyst (see text for details of each type). Arrows indicate the path of nuclear migration. Resting spores are depicted at the far right in each series.

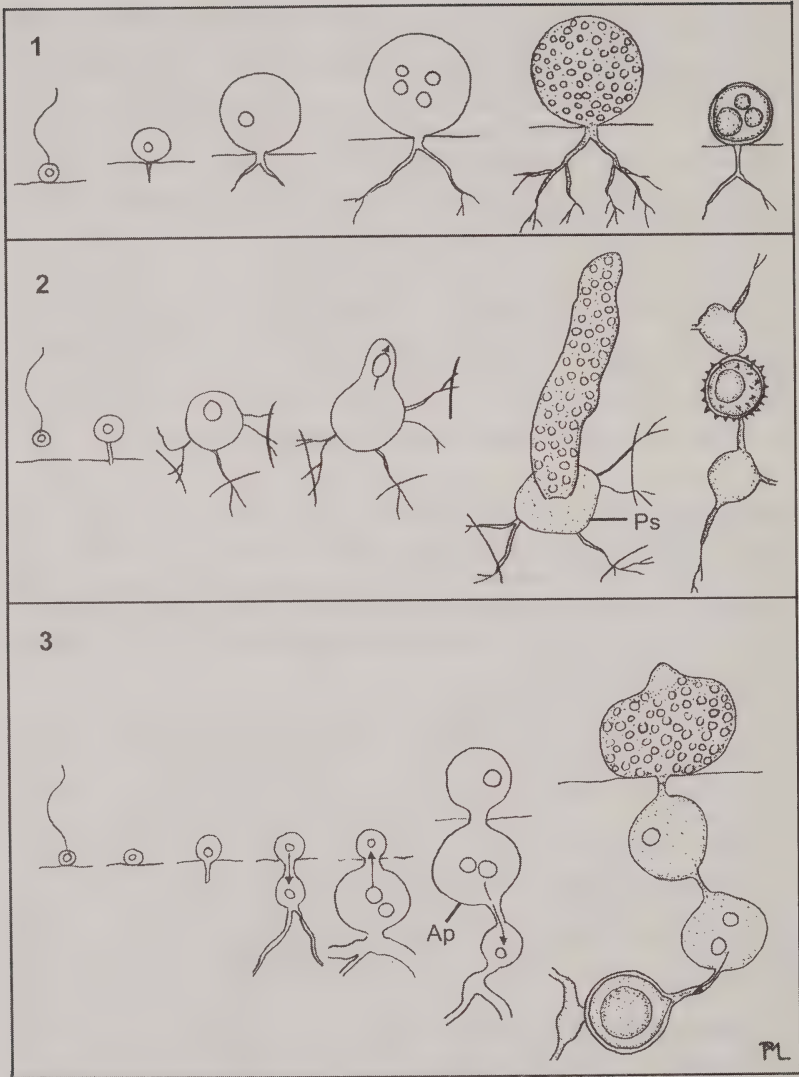


Fig. 1. Type #1 development, in which the zoospore cyst enlarges directly into the sporangium, e.g., *Rhizophydium*.

Fig. 2. Type #2 development, in which the zoospore cyst forms a prosporangium (Ps), which in turn produces the sporangium, e.g., *Polyphagus*.

Fig. 3. Type #3 development, exemplified by the endo-exogenous development of *Chytridium lagenaria*. Typically, an intramatrix apophysis (Ap) enlarges, subsequently contributing to the development of an extramatrix sporangium.

instances the rhizoidal region may develop a series of apophyses, or intramatrical resting spores, with associated rhizoidal connections, approaching a polycentric habit (Blackwell et al. 2002). Occasionally, in *C. lagenaria*, secondary sporangia may be proliferated basally, within the primary sporangium, from continued generative activity of the initial apophysis (Blackwell & Powell 2000). The term “endo-exogenous” in the case of *C. lagenaria* refers specifically to the alternating (generative) activities of the apophysis and sporangium, respectively—not per se to nuclear migration, though this of course may be involved in the activities of generative structures.

Figure 3

In addition to *Chytridium lagenaria*, *C. oedogonii* (Couch 1938) appears to develop in a generally endo-exogenous fashion (Blackwell et al. 2002). And, it is probable that the genus *Canteria*—described by Karling (1971), based on *Phlyctidium apophysatum* Canter (1947)—also develops in this way (Karling 1971, 1977). According to Hanson (1946), *Catenochytridium* has a mode of development resembling that of *Chytridium lagenaria*. However, Sparrow (1960) noted that the behavior of the zoospore cyst nucleus in *Catenochytridium* apparently differs from that of *Chytridium lagenaria*. Sparrow (1960) considered that “endo-exogenous thallus development” may differ mainly in degree from, or be merely a special case of, the usual acropetal sporangial development, based on a nourishing system of rhizoids, found in many chytrids. However, apparent nuclear “remigrations”—from intramatrical apophysis back to extramatrical sporangium (the two apparently separated structures remain connected by the original germ tube)—and a potential for continued sporangial proliferation based on such migrations (in *C. lagenaria*), support the idea of the distinctive character of this developmental type.

Type #4. The zoospore cyst nucleus migrates into the zoospore germ tube. An intramatrical enlargement of the germ tube, containing the migrated zoospore cyst nucleus, develops into the sporangium; rhizoids can develop from the incipient sporangium and/or the tip of the germ tube. The sporangial thallus is thus typically endobiotic, e.g., the eucarpic genera, *Entophlyctis* and *Endochytrium*. In the holocarpic genus *Olpidium*, lacking rhizoids, the nucleus and cytoplasm migrate (together) out of the zoospore cyst, and are released into the host cytoplasm as a protoplast by means of an injection peg (equivalent, in a comparative morphological sense, to the germ tube of the eucarpic genera mentioned in this category).

Figure 4

Type #5. The zoospore cyst nucleus migrates into the germ tube. An intramatrical enlargement of the germ tube (containing the migrated nucleus) develops into an apophysis which may function as a prosporangium, producing the sporangium. The zoospore cyst nucleus passes into the developing sporangium, where nuclear divisions result in zoospores. This pattern of development is

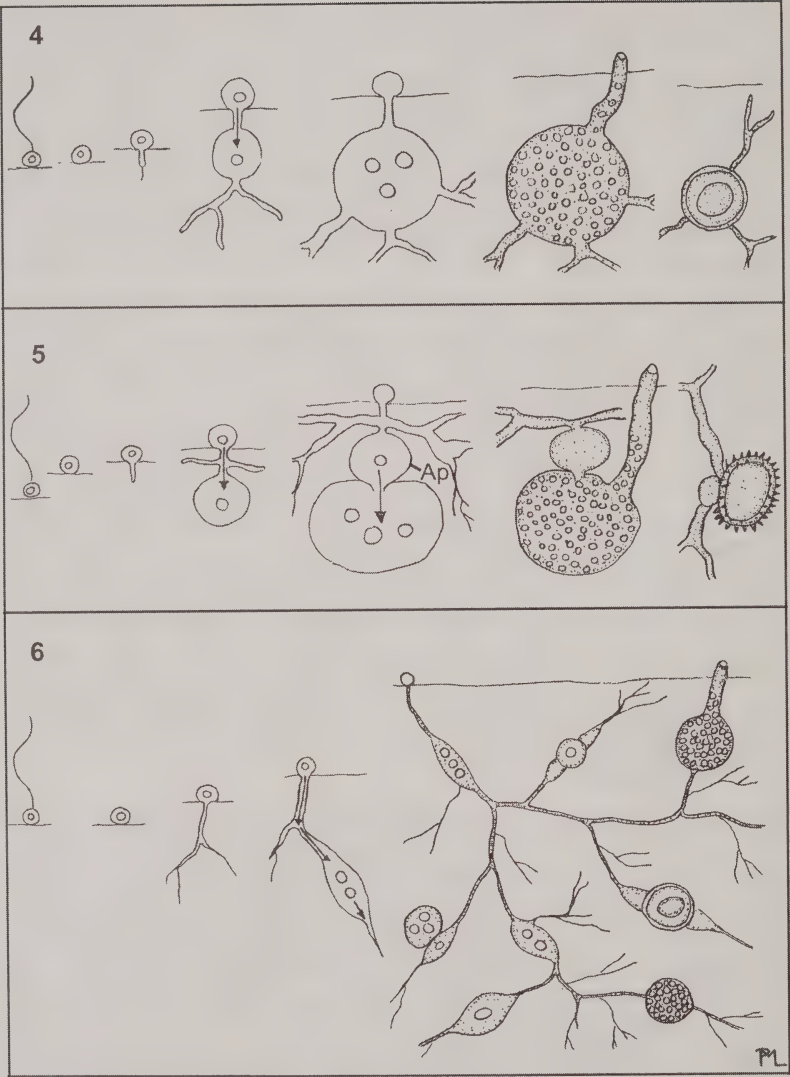


Fig. 4. Type #4 development, in which an intramatrical swelling of the zoospore germ tube becomes the sporangium, e.g., *Entophlyctis*.

Fig. 5. Type #5 development, similar to type #4, but an apophysis (Ap) contributes to sporangial formation, e.g., *Diplophlyctis*.

Fig. 6. Type #6 (polycentric) development. Illustrated here by a rhizomycelial form, *Cladochytrium*, polycentric development spans an array of developmental forms.

considered characteristic of *Diplophlyctis* (Whiffen 1944) but, as Sparrow (1960) discussed, the development of *Diplophlyctis* can be quite variable. In any case, rhizoids typically form from the apophyseal portion of the endobiotic thallus. Both *Nephrochytrium* (endobiotic) and *Asterophlyctis* (epibiotic or interbiotic) exhibit developments bearing some similarity to *Diplophlyctis*. In *Asterophlyctis*, the sporangium typically develops from the germ tube, proximal to the developing apophysis.

Figure 5

A category recognized by both Sparrow (1943) and Whiffen (1944)

Type #6 (polycentric). The nucleus of the zoospore cyst migrates into the germ tube. The germ tube and proliferated nuclei ultimately give rise to multiple centers of zoospore development (i.e., sporangia), connected by rhizoids. Such a polycentric thallus is typically intramatrical. Polycentric forms may be either operculate or inoperculate (Sparrow 1943, 1960), an indication that the polycentric habit may tell us relatively little about relationships. The classifications of Sparrow (1943) and Whiffen (1944) are somewhat contradictory concerning polycentric forms, although both authors based family status, in one or more cases, on this type of thallus. The polycentric habit probably arose a number of times in different systematic groups (cf. Blackwell et al. 2004), even within genera and species. For example, the monocentric genus *Rhizophlyctis* (see type #1) may rarely exhibit a polycentric form (Karling 1947, Sparrow 1960). *Karlingiomyces*, also fundamentally monocentric, has one species that can show polycentric growth (Blackwell et al. 2004). *Phlyctorhiza variabilis* (Karling 1951), transferred to *Catenophlyctis* by Karling (1965), is monocentric for a time, but may subsequently develop in a polycentric manner; certain strains are apparently more prone to be polycentric than others. Thallus development of *Catenophlyctis* supports Barr's (1978) supposition that the polycentric habit is derived, relative to the monocentric state. The matter of "number of sporangial centers per thallus" is not resolved in all genera; *Endochytrium* is a case in point. Karling (1977, p. 196) discussed *Endochytrium* as the "operculate counterpart of *Entophlyctis*" (a typically monocentric genus). Sparrow (1933a) originally described *Endochytrium* as polycentric, but Karling (1937) believed that *Endochytrium* was exclusively monocentric. Karling (1977, p. 196) eventually concluded, however, that the thallus of *Endochytrium* is "predominantly monocentric."—a conclusion with which we concur, but one that still warrants investigation.

Figure 6

The polycentric habit of a chytrid, at the level of order and family, is not as defining systematically as once thought. Certain predominantly monocentric chytrids (e.g., *Karlingiomyces*) are now predicted to cluster with clades that are generally polycentric (cf. James et al. 2000, Blackwell et al. 2004). Furthermore, there is considerable variation of thallus, even thallus type, within the general category

of polycentric habit—a topic that should be further investigated. Certainly, not all polycentric thalli are equivalent; in fact, differences in details of polycentric habit among rhizomycelial chytrids are often useful in delimiting genera, e.g., *Cladochytrium* and *Nowakowskiella*. The general category “polycentric chytrids” is thus diverse and difficult to assess. In contrast to monocentric chytrids, which typically exhibit determinate growth, polycentric chytrids often have a more extensive, indeterminate growth form (Sparrow 1960), limited in some cases by the confines of the substrate. Barr (1990), however, conceived of “polycentric” very broadly—to include not only rhizomycelial forms (with indeterminate growth) such as *Nowakowskiella* and *Cladochytrium*, but indeterminate filamentous forms such as *Monoblepharis* and *Gonapodya*, and also determinate colonial forms such as the holocarpic genus *Synchytrium*. Obviously, “polycentric chytrids” are a heterogeneous category, requiring taxonomic refinement through ultrastructural and molecular studies.

The contribution of Roane & Paterson (1974)

Type #7. Roane & Paterson (1974) reviewed Whiffen's (1944) work and provided simple diagrammatic illustrations of developmental patterns, based on the illustrations of Whiffen. Roane & Paterson accepted Whiffen's categorization of five developmental types in eucarpic monocentric *Chytridiales*, but added an additional type of monocentric development, similar to type #3, but in which the apophysis is consistently smaller than the developing sporangium, e.g., *Chytriomycetes hyalinus*. Though highlighting *C. hyalinus* in this “new” developmental type, Roane & Paterson mentioned the occurrence of similar forms in *Phlyctochytrium powhatanense* and *Chytridium ottariense*. *Chytriomycetes aureus* may also exhibit a relatively small apophysis, i.e., in relation to the sporangium (cf. Karling 1945, Letcher & Powell 2002). **Figure 7**

A problem with this additional category recognized by Roane & Paterson (1974) is that in certain chytrids, e.g., *Chytridium schenkii*, the sporangium and apophysis can develop, and remain, at a comparable size. Some authors (Koch 1957, Miller 1968, Letcher & Powell 2005) found, particularly in the genus *Phlyctochytrium*, that the apophysis is a character of insufficient consistency for definitive taxonomic use. In *Chytriomycetes spinosus* (Fay 1947) an apophysis may be present, though it is typically lacking. Beyond the matter of presence or absence, the question of what an apophysis actually represents has never been satisfactorily answered (Blackwell et al. 2002). The apophysis has a strongly generative function in some instances (e.g., *Chytridium lagenaria*), in which it contributes significantly to sporangial development; but, this is not necessarily so in other cases (e.g., *Chytriomycetes aureus*, *Phlyctochytrium planicorne*). An apophysis is often intimately associated with rhizoid development, e.g. *Chytridium aggregatum*, *Chytriomycetes aureus*, *Chytriomycetes*

hyalinus, *Phlyctochytrium planicorne*, and *Podochytrium dentatum*. However, such a subsporangial swelling may occasionally not be associated with rhizoids; *Chytridium inflatum* has what is apparently a distinct apophysis, but rhizoids are not evident (Sparrow 1960); *Caulochytrium* possesses a subsporangial (haustorial) swelling, lacking rhizoids (Powell 1981). Karling (1932) suggested that the apophysis represents a “homeotic” feature—an additional, fundamentally sporangial, structure. While interesting, a thesis of homeosis could be argued mainly in cases in which both sporangium and apophysis originate from the same immediate precursor (i.e., the germ tube), and then only if the apophysis is generative or “prosporangial” in function. *Diplophlyctis* is one of a few possible candidates for this interpretation.

A further difficulty presented by Roane & Paterson’s developmental type (type #7 herein) is that the potential for endo-exogenous development (sensu Karling 1936, i.e., type #3), versus primarily exogenous development (as presumably occurs in type #7), is not necessarily differentiated among all chytrids possibly falling in type #7, cf. *Chytridium cejpai* (Fott 1950). *Chytridiomyces hyalinus* may in some instances have “catenulate apophyses” (Roane & Paterson 1974, p. 147), suggestive of the sort of endo-exogenous development characteristic of *Chytridium lagenaria* (see discussion under type #3). Another problem with Roane & Paterson’s pattern developmental type is that it does not adequately address the position of resting spores—putatively epibiotic in *Chytridiomyces*, and endobiotic in species potentially included in *Chytridium* (cf. Karling 1945, Sparrow 1960, Letcher & Powell 2002). Roane & Paterson (1974, p. 147) stated that position (we assume, location with regard to substrate) of the resting spore in *Chytridiomyces hyalinus* was “not constant”; however, they did not explain this variability. The boundaries of this type #7 are not clear. Nonetheless, there is a certain utility in continuing to recognize this developmental type.

Polyphlyctis (cf. Karling 1967a, Batko 1975), based on two species placed originally in *Phlyctochytrium* (Willoughby & Townley 1961, Willoughby 1965), is an unusual, variably apophysate genus; the apophyses sometimes develop in a catenulate fashion (as mentioned, occasionally also observed in *Chytridiomyces hyalinus*). In *Polyphlyctis*, the zoospore cyst splits longitudinally into two halves or “hemicysts” (Willoughby & Townley 1961, Willoughby 1965); but, the protoplasts of the halves apparently never lose continuity, and an essentially normal, monocentric sporangial development ensues (cf. Willoughby 1965, Fig. 1; Karling 1967a, Plate 15, Fig. 1). Evidence of the earlier “split” development of *Polyphlyctis* remains, though, in the usual persistence of each half of the zoospore cyst wall, often on opposite sides of the sporangium (Willoughby 1965, Karling 1967a, 1977). Both species of *Polyphlyctis* should be re-examined to ascertain if their mode of development represents a variant within type #7, or fits better in type #3, or possibly constitutes a unique mode of development.

Recognition of an additional developmental type (*Podochytrium*)

Type #8. We herein suggest that an additional pattern of thallus development is exhibited in members of *Podochytrium*, including the diatom parasites *Podochytrium clavatum*, *P. lanceolatum*, and *P. cornutum* (cf. Sparrow 1960); possibly in a formally undescribed species of *Podochytrium* found in Iceland (Johnson & Howard 1968); and in the saprotrophic *Podochytrium chitinophilum* (Willoughby 1961). In this “*Podochytrium*-type” of development, the encysted zoospore does not expand appreciably, but undergoes an apparently unique bipolar development. A germ tube forms from the proximal face of the encysted zoospore, penetrates the substrate and develops (intramatically) into the rhizoidal system. The zoospore cyst also functions, without significant enlargement or change in shape, as a prosperangium, and generates the sporangium. The sporangium, however, is produced in an unusual manner; it develops (enlarges, elongates) only from the apical portion (distal face) of the encysted zoospore. Structurally, the main body of the zoospore cyst does not appear to be involved in this alteration, and remains unchanged, or exhibits only slight expansion or minor wall thickening. This cyst body persists as a sterile basal cell subtending the usually somewhat larger sporangium, from which it is typically delimited by a sub-basal septum. The epibiotic “sporangial apparatus” of *Podochytrium* thus becomes obviously differentiated into a distal zoosporogenous portion (sporangium) and a smaller, proximal, sterile, knob-like structure (the basal cell). The sporangium is inoperculate, usually becomes somewhat longer than broad, and typically opens by a single apical discharge pore. This developmental interpretation of *Podochytrium* is consistent with Pfitzer’s (1870) original concept and description of the genus, based primarily on the unequally two-parted sporangial apparatus. **Figure 8**

As for other species of *Podochytrium*, the chitinophilic *P. dentatum* (Longcore 1992) likewise fits type #8, although a limited expansion of the zoospore cyst may occur prior to bipolar development. Following apical budding of the cyst, the resultant young sporangial apex becomes bifid, unusual among Chytriomycota. Additionally, a swelling of the proximal rhizoidal area (i.e., closest to the basal cell of the sporangial apparatus) occurs. However, the apophysis-like rhizoidal structure does not function as a prosperangium or sporangium. This apophyseal region is sometimes delimited from the basal cell of the sporangial apparatus by a wall, and appears only to serve the purpose of proximal connection of rhizoids. *Podochytrium emmanuelense*, a parasite of diatoms, exhibits development as outlined in type #8, but may additionally show a degree of endo-exogenous development (sensu Karling 1936; see illustrations in Karling 1977, Plate 33, Figs. 23-25); it is therefore somewhat comparable to types #3 and #7, as well as type #8.

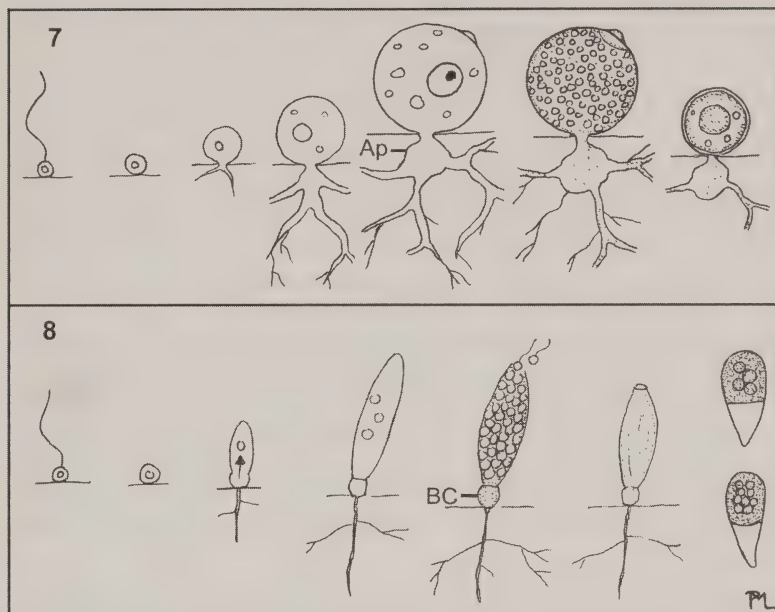


Fig. 7. Type #7 development. Similar to type #3, but the apophysis (Ap) is typically smaller than the developing sporangium, e.g., *Chytrium aureus*.

Fig. 8. Type #8 development. An additional developmental type recognized herein, exemplified by *Podochytrium*—*P. lanceolatum* and *P. clavatum* (resting spore only) are illustrated. Development of the zoospore is bipolar, the sporangium arising from the apical portion of the zoospore cyst. The zoospore cyst usually undergoes little or no enlargement or apparent differentiation, but is retained as a sterile, basal cell (BC).

As Powell & Koch (1977) noted, nuclear migratory behavior in chytrids can be variable among species of a given genus, and even within a single species. In *Podochytrium*, however, the pattern of nuclear migration appears to be similar among the taxa. Development of all *Podochytrium* species, including *P. emmanuelense*, is “endogenous” in the sense of Barr (1990), in that the nucleus of the zoospore cyst does not migrate into the germ tube. As explained in the introduction, Barr’s terminology (“exogenous” and “endogenous”), concerning whether the cyst nucleus migrates into the germ tube or not, presents difficulty because of prior use of these terms to describe sporangial position relative to the substrate. Beyond this, *Podochytrium* exemplifies a further developmental/morphological problem associated with the “endogenous/exogenous” terminology and concept, when applied to the zoospore cyst nucleus. In the context of the zoospore cyst, “endogenous” implies a non-migrating cyst

nucleus. But, this can be misleading, because what Barr (1990), Longcore (2002) and others specifically meant by “endogenous” was that the cyst nucleus does not migrate into the germ tube (not that it doesn’t migrate at all). The zoospore cyst nucleus of *Podochytrium*, though technically “endogenous”—and indeed not migrating into the germ tube—does, nonetheless, undergo migration. Migration in this case, though, is from the cyst (prosporangium) into the sporangium formed as an apical outgrowth of the cyst. The zoospore cyst is in the process “left behind” as a sterile, supporting structure (basal cell). So, the case of *Podochytrium* and certain other examples (such as the development of *Polyphagus*) are among the reasons why it is preferable (when referring to the zoospore cyst nucleus) to use the broader and less encumbered terms, “migratory” and “non-migratory,” instead of “exogenous” and “endogenous.” Perhaps it would be helpful to recognize two categories of “migratory,” one denoting migration of nucleus from cyst to germ tube (as in typical *Entophlyctis* development), and the other (as in *Podochytrium*) referring to migration from prosporangium to sporangium. In truly non-migratory “behavior,” e.g., *Rhizophydium*, the zoospore cyst nucleus does not physically move into another structure of any kind, but remains in the cyst which develops directly into a sporangium.

A readily discernible feature that sets typical *Podochytrium* development apart from other chytrid developmental types is that no significant expansion or change in shape of the zoospore cyst usually occurs, although it functions as a prosporangium. A sporangium simply forms from the apex of the otherwise apparently unaltered cyst. The germ tube forms at the “pole” of the cyst opposite the “sporangial end,” and it typically undergoes no appreciable dilation to form any additional sporangial, prosporangial, or apophyseal structure (a rhizoidal dilation may occur in *P. dentatum*, as mentioned). The epibiotic resting spore of *Podochytrium* usually forms from the sporangium proper. The basal cell typically makes no contribution to the structure of the resting spore, but may remain attached to it—in some instances a useful additional recognition character.

Discussion

Whether other genera of monocentric Chytridiomycota conform to the *Podochytrium* type of development, or whether still other developmental types exist, remains to be demonstrated. But, such is worthy of further investigation. The genus *Sporophlyctidium* (Sparrow 1933b) may produce a small thallus superficially similar to that of *Podochytrium*. However, the thallus of *Sporophlyctidium* appears to be derived by a modification of type #1, rather than being formed in the manner of *Podochytrium* (type #8). In

Physorhizophidium, the apparent knob-like base of the sporangium is not developmentally comparable to the basal cell of *Podochytrium*; the epibiotic “knob” (subsporangial swelling) of *Physorhizophidium* is in fact secondarily formed (Sparrow 1943), and not part of the original sporangial apparatus. In *Saccomyces*, a genus with a “two-celled” epibiotic structure (sporangial apparatus) resembling *Podochytrium* (see Sparrow 1960, Karling 1977), the basal portion (cell) is a distinct prosperangium, modified (somewhat in size, but especially in shape) from the zoospore cyst. The prosperangium in *Saccomyces* forms the sporangium, but as a lateral, not apical, elaboration. In mode of development, *Saccomyces*, except for being epibiotic (and endobiotic), is most similar to the interbiotic forms, *Polyphagus*, *Endocoenobium*, and *Sporophlylctis* (see type #2). The two-celled “sporangial” structure in *Septosperma* is actually the resting spore stage, rather than the sporangium (cf. Sparrow 1960, Blackwell & Powell 1991). An apparent two-celled structure in *Rhizophydium ovatum* is a product of sexual reproduction (Couch 1935), not of asexual development and differentiation of the zoospore cyst. Sparrow (1960) likened *R. clinopus* to *Podochytrium*. However, the “basal cell” of *R. clinopus* never separates by a septum from the sporangium (unlike the case of *Podochytrium* where it does), and the entire sporangial apparatus in *R. clinopus* develops in a unitary fashion from the zoospore cyst (type #1), not in the progressive (polar) manner of *Podochytrium* (type #8). *Chytridium cejpai* exhibits a morphology apparently similar to *Rhizophydium clinopus* and to *Podochytrium* (e.g., *P. clavatum*). However, *C. cejpai* is operculate, apophysate, and is seemingly well placed in *Chytridium*. As with *Rhizophydium clinopus*, the apparent “basal cell” of *Chytridium cejpai* is never delimited by a septum from the sporangium (again, a point of distinction from *Podochytrium*). Perhaps these examples serve to exemplify that inclusion of developmental pattern and thallus morphology in studies of chytrids—particularly systematic assessments of chytrid genera, and species—will continue to prove useful.

The occurrence of chytrids with apparently similar, yet developmentally different, thalli underscores not only the complexity of chytrid development but, particularly, the importance of developmental studies in investigations of the systematics of Chytridiomycota. In contrast to Whiffen’s (1944) basic suggestion of the use of thallus developmental types in establishing chytrid groupings (families, subfamilies), we consider parameters of thallus development to be more significant in chytrid taxonomy at the genus and species levels than at higher ranks. Barr (1980), as mentioned, doubting the reliability of classical features at higher ranks, shifted emphasis in chytrid systematics from consideration of matters of thallus form and structure to the details of zoospore ultrastructure. This ultrastructural approach was eventually extended (e.g., Barr 1990, 2001; Powell & Roychoudhury 1992) to a definition

of zoospore types for all major chytrid groups. There is no question that Barr's ultrastructural viewpoint greatly progressed knowledge of the systematics of Chytridiomycota, enhancing our understanding of chytrid orders and families. There is also no question that the molecular work of James et al. (2000) and Letcher et al. (2004) further bolstered our understanding of the outlines of chytrid systematics, in both broad and more specific terms. It is clear from the work of Barr and of James et al. that thallus types (and operculation, for that matter) do not necessarily follow major phylogenetic lines. The "*Chytriomycetes* clade," for example, encompasses different thallus forms (and both operculate and inoperculate taxa), cf. Letcher et al. (2004). Considerable variation in thallus morphology is found even within the genus *Chytridium* (Blackwell et al. 2002); the eventual inclusiveness of this genus remains uncertain. Critical study of thallus development may eventually help resolve the generic circumscription of *Chytridium* and possibly segregate other apparently related genera.

In the light of improved understanding of chytrid phylogeny based on ultrastructural and molecular information, it does not appear that chytrid thallus morphology will be especially useful in deciphering higher ranks of Chytridiomycota. The fact that thallus morphology and development are not especially informative at macrosystematic levels is due in large part to convergence of thallus forms among larger phylogenetic groupings. However, thallus development can still play an important role in resolving pragmatic questions of chytrid form and distinctiveness at generic and specific levels. We believe, especially, that knowledge of thallus development will assist in addressing questions concerning what features are merely superficially similar and what features truly distinguish the thallus (and development of the zoospore) of one apparently comparable chytrid genus from another. *Podochytrium* is a prime example where developmental information has improved our understanding of the genus, and its delimitation from what might at first seem to be very similar chytrid genera. In possible contrast to higher phylogenetic groupings, detailed knowledge of thallus development may well be seen to interface better with more narrowly targeted ultrastructural and molecular investigations, now in progress, i.e., those involving distinctions of chytrid genera and species.

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A new species of *Phyllachora* (*Phyllachorales*) on *Leguminosae* from China

NA LIU^{1,2} & LIN GUO^{1*}

liuna3456@163.com *guol@sun.im.ac.cn

¹Key Laboratory of Systematic Mycology and Lichenology
Institute of Microbiology, Chinese Academy of Sciences
Beijing 100080, China

²Graduate University of Chinese Academy of Sciences
Beijing 100049, China

Abstract—A new species, *Phyllachora yunnanensis* on *Lespedeza formosa* and *Lespedeza* sp., causing tar spots is reported. Based on the characters of tar spots, ascomata, asci and ascospores, the new species differs from other similar species in the number, the shape and the size of ascospores.

Key words—Sordariomycetidae, tar spot, taxonomy

A new species of *Phyllachora* on leaves of *Lespedeza formosa* was collected from Yunnan Province in the autumn of 2005. So far only one species of *Phyllachora* has been recognized on the genus of *Lespedeza*: *Phyllachora lespedezae* (Schwein.) Sacc. (Saccardo 1883: 614) with ellipsoidal to ovoid and slightly inaequilateral ascospores measuring 11–17 x 5–8.5 µm. According to Cannon (1991) monograph on *Leguminosae*, *Phyllachora lespedezae* is 4-spored. The new species differs from *Phyllachora lespedezae* in having 8-spored asci, smaller ascospores (7–13.5 x 5–9 µm) and ellipsoidal, ovoid or subglobose ascospores.

Petrak & Ahmad (1954) once reported a record of *Phyllachora lespedezae* from Pakistan which is 8-spored. Müller (1986) renamed the specimen as *Diachora lespedezae* E. Müll. Cannon (1991) transferred the species to the genus *Vitreostroma* as *Vitreostroma desmodii* subsp. *lespedezae* (E. Müll.) P. F. Cannon with ellipsoidal to ovoid ascospores measuring 14.5–17 x 8–9 µm which produces mature ascospores from fallen overwintered leaves. The new species differs from *V. desmodii* subsp. *lespedezae* in having smaller ascospores.

* corresponding author

Thus, a new species is described as:

Phyllachora yunnanensis Na Liu & L. Guo, sp. nov.

Figs. 1-4

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Maculae in epiphylllo, 0.2–0.6 mm diam., nigrae, nitidae. *Ascomata* 180–380 x 110–200 μ m, in *mesophyllo folii immersa*, subglobosa vel ellipsoidea. *Asci* 50–88 x 10–20 μ m, octospori, clavati, unitunicati, pedunculati. *Ascosporae* 7–13.5 x 5–9 μ m, uniseriatae vel irregulariter biseriatae, unicellulares, hyalinae, ellipsoideae, ovoideae vel subglobosae.

Leaf spot: the included leaf tissue becoming yellow. Blackened regions sparse or aggregated, roughly circular, 0.2–0.6 mm in diam, shining black, rising from the upper leaf surface, 1- to 2- loculate, the ostiole conspicuous, sunken, blackened regions only visible from the adaxial surface.

Anamorph: not seen.

Teleomorph: ascomata 180–380 x 110–200 μ m, epigenous, immersed in the mesophyll layer of the leaf, subglobose or ellipsoidal, some irregularly shaped due to compression forces, with a conical neck extending through the host epidermis and cuticle layer to the surface, ostioles conspicuous and with well-developed, hyaline periphyses, asci rising from the basal and lateral wall of the ascoma. Upper wall to 48 μ m thick, composed of epidermis cells which are occluded by melanized material. Lower wall to 53 μ m thick. Lateral wall to 20 μ m thick, composed of thin-walled cells. Paraphyses to 3 μ m wide, thin-walled, gradually tapering, branched, septate. Asci 50–88 x 10–20 μ m, 8-spored, clavate, obtuse at apex, short pedunculate, thin-walled at maturity, unitunicate. Ascospores arranged uniseriate or irregularly biseriate, 7–13.5 x 5–9 μ m, ellipsoidal, ovoid or subglobose, one-celled, hyaline, thin-walled, smooth, guttulate, without a gelatinous sheath.

Specimens examined—On living leaves of *Lespedeza formosa* (Vogel) Koehne (*Leguminosae*), Yunnan: Lijiang, Haibei, alt. 2560 m, 16 IX 2005, N. Liu, Z.Y. Li & L. Guo 115, HMAS 140198 (holotype); On *Lespedeza* sp., Yunnan: Kunming, VII 1938, R. Xu, HMAS 4689 (paratype).

The HMAS 4689 specimen was wrongly identified as *Phyllachora lespedezae* by Jiang Guangzheng (Tai 1979). Now it is changed to *Phyllachora yunnanensis* as a paratype. *Phyllachora lespedezae* has been recorded by Petrak (1947) and Tai (1979) in China. It has not been examined by the authors, because a specimen was not kept.

So far in China, five *Phyllachora* taxa on *Leguminosae* have been reported: 1) *Phyllachora bauhiniiae* (G. Winter) Theiss. & Syd. var. *bauhiniiae* [syn. *Phyllachora bauhiniiae* Sawada (Sawada 1943)]; 2) *Phyllachora punctum* subsp.

Figs. 1-4. *Phyllachora yunnanensis* on *Lespedeza formosa* (HMAS 140198, holotype). Fig. 1. Section through immersed ascoma. Figs. 2-4. Differential interference micrographs of asci and ascospores.



1



2



3



4

dalbergiicola (Henn.) P.F. Cannon [syn. *Phyllachora dalbergiicola* Henn. (Teng 1963)]; 3) *Phyllachora lespedezae* (Petrak 1947); 4) *Phyllachora dolichogena* subsp. *phaseolina* (Syd. & P. Syd.) P.F. Cannon [syn. *Phyllachora phaseolina* Syd. & P. Syd. (Sawada 1943)] and 5) *Phyllachora yunnanensis* (in this paper).

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***Repetobasidiopsis* gen. nov. (Basidiomycetes) from Eastern Himalaya, India**

G.S. DHINGRA & AVNEET P. SINGH

dhingragurpaul@rediffmail.com

Department of Botany, Punjabi University

Patiala - 147 002 India

Abstract—*Repetobasidiopsis* and the species *Repetobasidiopsis grandisporus* are described from India. The new species is characterized by resupinate, adnate, very thin, non-poroid fruit bodies, monomitic hyphal system, hyphae without clamps forming a compact, gelatinized basal region, a compact, short-celled sub-hymenial zone appearing pseudoparenchymatous, thin-walled, sinuous cystidia, subclavate with suburniform constriction to somewhat sinuous basidia, with linear repetition, and ellipsoid to subfusiform or subballantoid basidiospores. These unique features also support erection of a new genus that shares some features with *Repetobasidiellum*.

Key words—Bamboo, Arunachal Pradesh, Bomdila

During a mycological excursion at Wang Basti (in Bomdila, Arunachal Pradesh, India), very thin, resupinate, non-poroid fruit bodies on decaying bamboos were collected by G.S. Dhingra. A microscopical examination showed monomitic hyphal system, hyphae without clamps forming a compact, gelatinized basal region, a compact, short-celled sub-hymenial zone appearing pseudoparenchymatous, basidia with linear repetition, and ellipsoid to subfusiform basidiospores. Some of the features remind of the genus *Repetobasidiellum* J. Erikss. & Hjorstad, though clearly separate from it. A sample was sent to Prof. Nils Hallenberg for comments, who remarked that it represented a unique collection that could not be assigned to an existing known genus in the *Corticaceae*. We feel this warrants describing a new species and proposing a new genus, which we name here as *Repetobasidiopsis*. The new genus shares some features with *Repetobasidiellum*, which Eriksson et al. (1981) assigned to the artificial family *Corticaceae* and where *Repetobasidiopsis* can also be assigned for the present time.

***Repetobasidiopsis* Dhingra & Avneet P. Singh gen. nov.**

Fructificatio resupinata, confertim adnata, effusa, hymenio subceracea, laevigata; systema hyphale monomiticum; hyphis tenuitunicatis, non-fibulatis, basilaris hyphis irregulariter ramosus et formo compactus textum, subhymenialis hyphis brachy cellularis, compactus et

visus pseudoparenchymatis; cystidia tenuitunicata, continetur non affico cum sulfovanillin; basidia subclavata ad suburniformae ortendo linearis repetitionis, 4-sterigmatibus; basidiosporae, ellipsoideae ad subfusiformae an suballantoideae, tenuitunicatae, non-amyloideae, non-cyanophileae.

Type species: *Repetobasidiopsis grandisporus* Dhingra & Avneet P. Singh sp. nov.

Etymology: The name of the genus is based on its possession of proliferating (i.e., repeating) basidia, similar to those found in *Repetobasidiellum*.

Fruit body resupinate, closely adnate, effuse, hymenial surface smooth, subceraceous; hyphal system monomitic; generative hyphae without clamps, basal hyphae irregularly branched and interwoven into a dense texture, subhymenial hyphae short-celled and compactly packed and appear like pseudo-parenchymatous tissue; cystidia thin-walled, negative to sulfovanillin; basidia subclavate to suburniform, showing linear repetition, 4-sterigmate; basidiospores ellipsoid to subfusiform, or suballantoid, smooth, thin-walled, acyanophilous, non-amyloid.

***Repetobasidiopsis grandisporus* Dhingra & Avneet P. Singh sp. nov.**

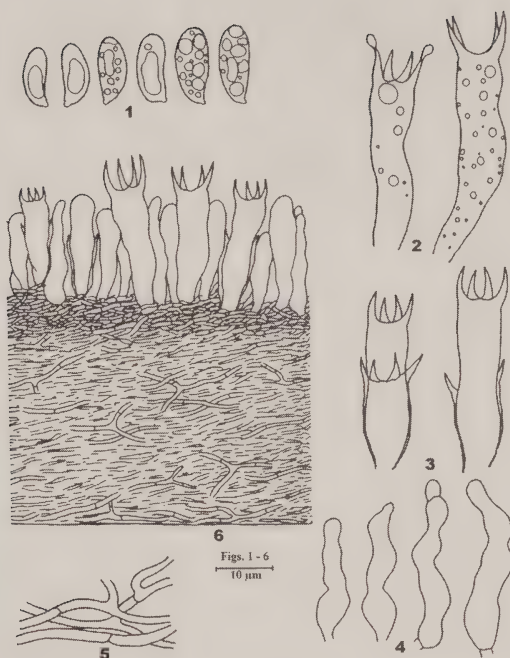
Figs. 1-7

Fructificatio resupinata, confertim adnata, effusa, perexigua, subceracea; superfacies hymenialis laevis, cremeus ad alboluteus. Systema hyphale monomiticum; hyphae ad 2.3 µm latum, tenuitunicatum, septatum, fibulis destitutum; basilaris hyphae irregularie ramosum in compactum textum; subhymenialis hyphae brackey cellularis, compaginatus, pseudoparenchymatis aspectus. Cystidii 20-30 x 5-6 µm, tenuitunicatus, sinuosus. Basidii 20-40 x 5.5-8 µm, subclavatus ad suburniformis, raro sinuosus, com linearis repetitionis, fibulis destitutus ad basis, 4-sterigmatibus, multiguttatus. Basidiosporii 10-14 x 4.0-5.8 µm, ellipsoideus ad subfusiformis an suballantoideus, tenuitunicatus, non-amyloideus, non-cyanophiles, cum unus grandis guttulatus an pluriguttulatus.

Holotypus: India, Arunachal Pradesh, Bomdila, Wang Basti, super putrescens bamboo, G.S. Dhingra 19706 (PAN, GH) Augustus 24, 1981.

Etymology: The name of the species is based on large sized spores in comparison to small sized spores in taxa within *Repetobasidiellum*.

Fruit body resupinate, closely adnate, effuse, subceraceous; hymenial surface smooth, creamish-white to yellowish-white, continuous when fresh, some cracks developing on drying; margin not well differentiated. Hyphal system monomitic; generative hyphae up to 2.3 µm wide, thin-walled, septate, without clamps; basal zone of gelatinized hyphae irregularly branched and interwoven; subhymenial hyphae short-celled and compactly packed and appear like pseudo-parenchymatous tissue. Cystidia 20-30 x 5-6 µm, thin-walled, sinuous, negative to sulfovanillin. Basidia 20-40 x 5.5-8 µm, subclavate to suburniform, rarely sinuous, with linear repetition, basal clamp is not observed, 4-sterigmate, with oily contents; sterigmata up to 8.5 µm long. Basidiospores 10-14 x 4.0-5.8 µm, ellipsoid to subfusiform, or suballantoid, smooth, thin-walled, acyanophilous, non-amyloid, with one large guttule or many small oil drops.



Figs.1-6. Microscopic structures from basidiocarp of *Repetobasidiopsis grandisporus*:
 1. Basidiospores; 2. basidia; 3. proliferating basidia; 4. cystidia;
 5. generative hyphae; 6. vertical section of the basidiocarp.

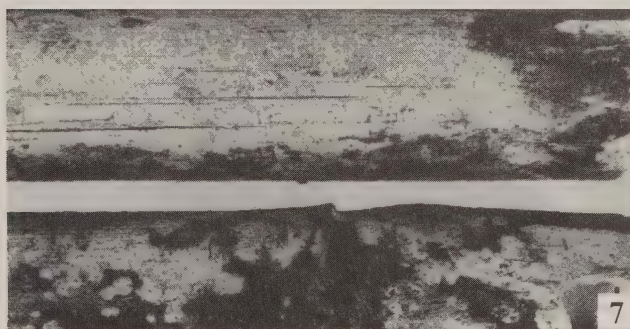


Fig. 7. *Repetobasidiopsis grandisporus* basidiocarp showing hymenial surface.

Acknowledgements

Authors thank Prof. Nils Hallenberg (Goeteborg, Sweden) and Dr. I.B. Prashar (Panjab University, Chandigarh, India) for valuable suggestions and peer review of the manuscript; DST, Govt. of India for financial assistance, and Head, Department of Botany for typing facilities.

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***Urocystis rostrariae*,
a new species of smut fungus on *Rostraria* from Jordan**

MARCIN PIĄTEK

mpiatek@ib-pan.krakow.pl

Department of Mycology, W. Szafer Institute of Botany
Polish Academy of Sciences, Lubicz 46, PL-31-512 Kraków, Poland

Abstract—*Urocystis rostrariae* is described and illustrated from infected leaves of *Rostraria cristata* (*Poaceae*) collected in Jordan. The new species is characterized by large spore-balls, comprising mostly 10–20 spores, which are surrounded by a continuous layer of sterile cells. *Urocystis rostrariae* is completely different from six other species of *Urocystis* known on closely related grass genera. This is a second smut fungus on the genus *Rostraria*. The only other smut fungus known on this genus is *Tilletia rostrariae* infecting ovaries of *Rostraria cristata*, and known only from the type locality in Iran.

Key words—Ustilaginomycetes, taxonomy, Middle East, Asia

Introduction

Rostraria Trin. is a small genus of grasses (*Poaceae*), with about 10 species distributed mostly in the Mediterranean and Middle East. According to Clayton & Renvoize (1986) it belongs to the subtribe *Aveninae* of the tribe *Aveneae*, together with 22 other grass genera. Some authors placed *Rostraria* in the subtribe *Koeleriinae* of the tribe *Aveneae* (Tzvelev 1976), together with *Trisetum* Pers., *Trisetaria* Forssk. and *Koeleria* Pers. The only smut fungus known on representative of *Rostraria* was *Tilletia rostrariae* Vánky & Ershad, described from infected ovaries of *Rostraria cristata* collected in Iran (Vánky & Ershad 2002). Between unidentified smut fungi obtained on loan from K there was one other species, infecting leaves of *Rostraria cristata*, collected in Jordan in the Middle East. Microscopic examination revealed that this smut belonged to the genus *Urocystis* Rabenh. ex Fuckel, but cannot be identified with any known species described to date. Therefore it is proposed here as new to science.

Light microscopy and SEM studies were as described by Piątek et al. (2005). The values of the size ranges are the means of 50 spore balls, spores and sterile cells measured in 5% KOH. SEM micrographs were taken in the Laboratory of Field Emission Scanning Electron Microscopy and Microanalysis at the Institute of Geological Sciences of the Jagiellonian University, Kraków (Poland).

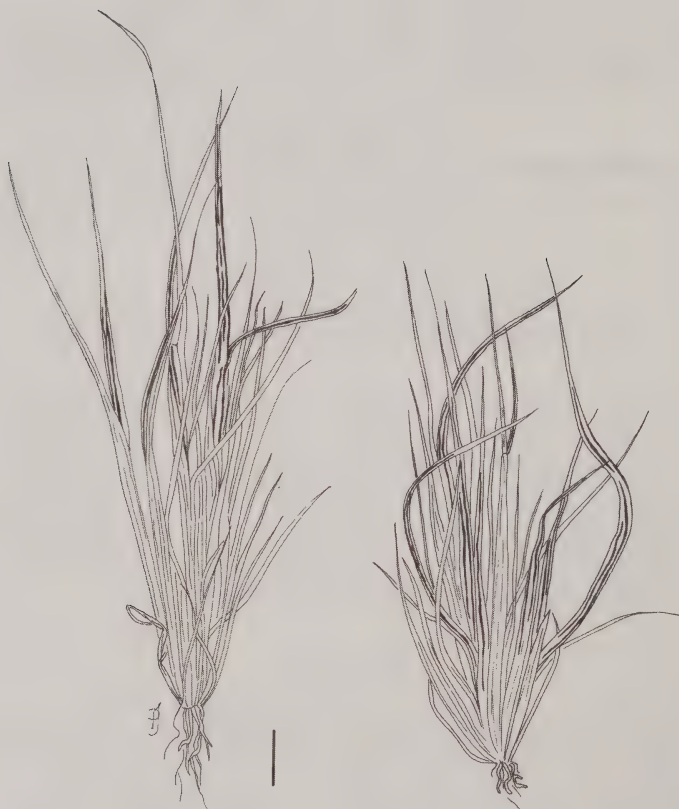


Fig. 1. Sori of *Urocystis rostrariae* in the leaves of *Rostraria cristata* (Holotype: K(M) 134351). Scale bar = 1 cm.

Taxonomy

Urocystis rostrariae M. Piątek, sp. nov.

[Mycobank MB 510056]

FIGURES 1–5

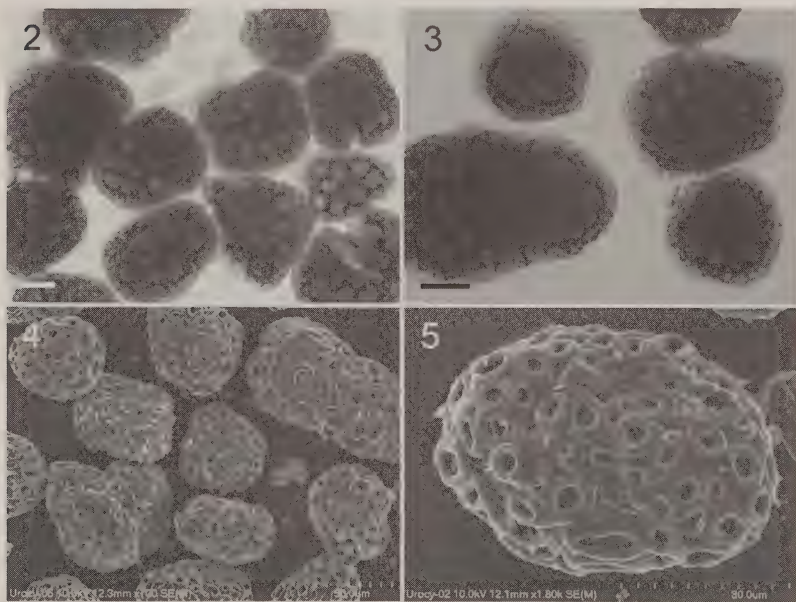
Typus in matrice *Rostraria cristata* (L.) Tzvelev (= *Lophochloa phleoides* (Vill.) Rchb.), Jordan, Jebel el Uweinid, W of Azraq, sandy wadi running from E bluff of a hill covered with basalt boulders, 21.IV.1965, C. C. Townsend 65/167 [holotypus: K(M) 134351!].

Sori in foliis, primo epidermide obtectas, deinde rupturas. Glomeruli sporarum subglobosi, ovoidei, ellipsoideales usque irregulares, (50–)60–80(–100) × (40–)50–60(–85) μm, e sporis

(6-)10-20(-40) (-vel plus?) compositi, cellulis sterilibus complete circumdati. Sporae globosae, subglobosae usque ovoideae, rubrobrunneae, (12-)14-18(-19) $\times$ (10-)12-15(-16) μm , pariete aequali, 1.0-1.5 μm crasso. Cellulae steriles globosae, subglobosae usque ovoideae, plerumque cum lateribus contactis deplanatis, flavae, (6-)9-13 $\times$ 6-10 μm , pariete inaequali, 1-2 μm crasso, levi.

Sori in leaves, forming long striae between the veins, at first lead-coloured and covered by the epidermis, which later ruptures exposing the blackish, powdery mass of spore balls. Spore balls subglobose, ovoid, ellipsoidal to irregular, (50-)60-80(-100) $\times$ (40-)50-60(-85) μm , composed of (6-)10-20(-40) (-or more?) central spores, completely surrounded by a layer of sterile cells. Spores globose, subglobose to ovoid, reddish-brown, (12-)14-18(-19) $\times$ (10-)12-15(-16) μm , wall even, 1.0-1.5 μm thick. Sterile cells globose, subglobose to ovoid, usually with flattened contact sides, yellow, (6-)9-13 $\times$ 6-10 μm , wall uneven, 1-2 μm thick, smooth.

Host and distribution--On *Poaceae*: *Rostraria cristata* (= *Koeleria phleoides* (Vill.) Pers.; *Lophochloa phleoides*); Jordan, Asia. Known only from the type locality.



Figs 2-5. Spores of *Urocystis rostrariae* as seen by LM and SEM (Holotype: K(M) 134351).

Scale bars = 20 μm for Figs. 2-3, 50 μm for Fig 4, 30 μm for Fig. 5.

Discussion

Urocystis rostrariae should be compared with other species of the genus *Urocystis* known on grasses included in the subtribe *Aveninae*. On the 22 grass genera included in this subtribe by Clayton & Renvoize (1986) only six species of *Urocystis* have been hitherto described, namely *U. avenae-elatioris* (Kochman) Zundel, type on *Arrhenatherum elatius* (L.) P. Beauv. ex J. Presl & C. Presl, *U. avenastri* (Massenot) Nannf., type on *Avenula pubescens* (Huds.) Dumort., *U. behboudii* (Esfand.) Vánky, type on *Arrhenatherum kotschyi* Boiss., *U. koeleriae* L. Guo, type on *Koeleria litvinowii* Domin, *U. rytzii* (Massenot) J. Müll., type on *Avenula versicolor* (Vill.) M. Lainz, and *U. triseti* (Cif.) Zundel, type on *Trisetum spicatum* (L.) K. Richt.

Urocystis rostrariae can be distinguished from these six species by the larger size of spore balls, by number of spores per spore ball and by the host plant species. *U. avenae-elatioris* has spore balls 16–36 µm in diameter, which are composed of 1–3(–4) spores. It is restricted to *Arrhenatherum elatius* and is known only from Europe (Vánky 1994). *U. avenastri* has spore balls 20–35 µm in diameter, with 1–4(–5) central spores, and the only host plant is *Avenula pubescens*. This species is so far known from a few sites in Europe (Vánky 1994). *U. behboudii* forms spore balls 17–50 µm in diameter, and they are composed of 1–3(–4) spores. This smut is known only from the type locality in Iran, where it parasitizes *Arrhenatherum kotschyi* (Esfandiari & Petrak 1950; Vánky 1985). *U. koeleriae*, which was recently described as new from China, has spore balls 19–38 µm in diameter, the number of spores per spore ball is 1–4(–5) and its only known host is *Koeleria litvinowii* (Guo 2005). However, there are also records of “*Urocystis agropyri*” on *Koeleria cristata* Pers. from the U.S.A. (Fischer 1953; Zundel 1953), which are unlikely to belong to *Urocystis agropyri* (Preuss) A. A. Fisch. Waldh., which is restricted to species of *Elymus*. Re-examination of the collections from the U.S.A. is necessary to determine the name of this fungus. *U. rytzii* has spore balls 17–51 µm in diameter, composed of 1–3(–5) spores, its only host plant is *Avenula versicolor*, and the smut is known only from three stations in Europe (Müller 1991). The last known species on the subtribe *Aveninae*, *U. triseti* has spore balls 20–40 µm in diameter, which are composed of 1–6 spores, and the smut parasitizes *Trisetum alpestre* P. Beauv., *T. flavescens* (L.) P. Beauv. and *T. spicatum* in Europe (Vánky 1994).

It should be mentioned here that in the literature there is another record of a *Urocystis* species on the subtribe *Aveninae*. Jørstad (1962) reported an unnamed *Urocystis* on *Deschampsia caespitosa* (L.) P. Beauv. from Iceland. This collection is preserved in O and was also examined in connection with the description of *Urocystis rostrariae*. The specimen probably belongs to a separate species that forms sori on leaves as long striae between the veins, and has spore balls 15–40

µm in diameter, which are composed of 1–4(–6) spores. This species will be described and discussed elsewhere.

The large number of spores per spore balls present in *Urocystis rostrariae* is also unusual amongst the remaining ca. 150 species of *Urocystis*. Most species in this genus have less than 10 spores per spore ball (often 1–3), while only a few species have spore balls composed of more than 10 spores. Several examples follow: *U. corsica* (Mayor & Terrier) Vánky on *Stipa capensis* Thunb. (6–15 spores per spore ball), *U. junci* Lagerh. on *Juncus* spp. (1–20 spores per spore ball), *U. paridis* (Unger) Thüm. on *Paris* spp. (1–30 spores per spore ball), *U. schizocaulon* (Ces.) Zundel on *Odontites luteus* (L.) Clairv. (8–30 spores per spore ball), *U. thaxteri* Vánky on *Hypoxis* spp. (5–25 spores per spore ball), and *U. trientalis* (Berk. & Broome) B. Lindeb. on *Trientalis* spp. (6–50 spores per spore ball).

Urocystis rostrariae is known only from the type locality in Jordan in the Middle East. *Tilletia rostrariae*, is the only other smut fungus recorded on the genus *Rostraria*, and is also only known from the type locality in Iran. However, *Rostraria cristata* – the host plant of these two smut fungi, is widely distributed in arid places of Mediterranean Europe and Africa, south-west Asia and as an introduced plant in southern Africa, Australia and America (Henderson & Schäfer 2003). Therefore, it is possible that both *Urocystis rostrariae* and *Tilletia rostrariae* are more common, but overlooked.

Acknowledgements

I am grateful to Dr. Kálmán Vánky (Tübingen, Germany) and to Dr. Roger G. Shivas (Indooroopilly, Australia) for reading the manuscript, checking my English, helpful improvements and serving as pre-submission reviewers, to my wife Dr. Jolanta Piątek (Kraków, Poland) for her skilful drawings, to Anna Łatkiewicz (Kraków, Poland) for assistance with the SEM micrographs, and to the Curators of K and O for loan of smut fungi specimens. This study was supported by the Polish Ministry of Education and Science (MEN) for the years 2005–2008, grant no. 2 P04G 019 28.

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***Trimitiella* gen. nov. (Basidiomycetes) from Eastern Himalaya, India**

G.S. DHINGRA

dhingragurpaul@rediffmail.com
Department of Botany, Punjabi University
Patiala-147 002, India

Abstract—*Trimitiella* is characterized by resupinate, non-poroid fruitbodies with a trimitic hyphal system, large sized basidia and basidiospores, and dendrohyphidia. *Trimitiella indica* from Eastern Himalaya is described as the type species.

Key Words—*Corticiaceae*, Arunachal Pradesh, West Kameng

While exploring the forests in the state of Arunachal Pradesh in Eastern Himalaya, the author collected a loosely attached, grayish colored resupinate fungus on decaying bamboo twigs. A microscopic examination of the collection revealed trimitic hyphal system, large sized basidia and basidiospores along with dendrohyphidia. The taxon could not be placed as new species in *Aleurodiscus* or *Laeticorticium*, also having large sized basidia and basidiospores along with dendrohyphidia, as both those genera have a monomitic hyphal system. A trimitic hyphal system is also found in the genus *Laurilia*, but here the spores and basidia are smaller, encrusted cystidia are present, and dendrohyphidia are lacking. In conclusion, it seems justified to place the new species with trimitic hyphal system in a new genus *Trimitiella*.

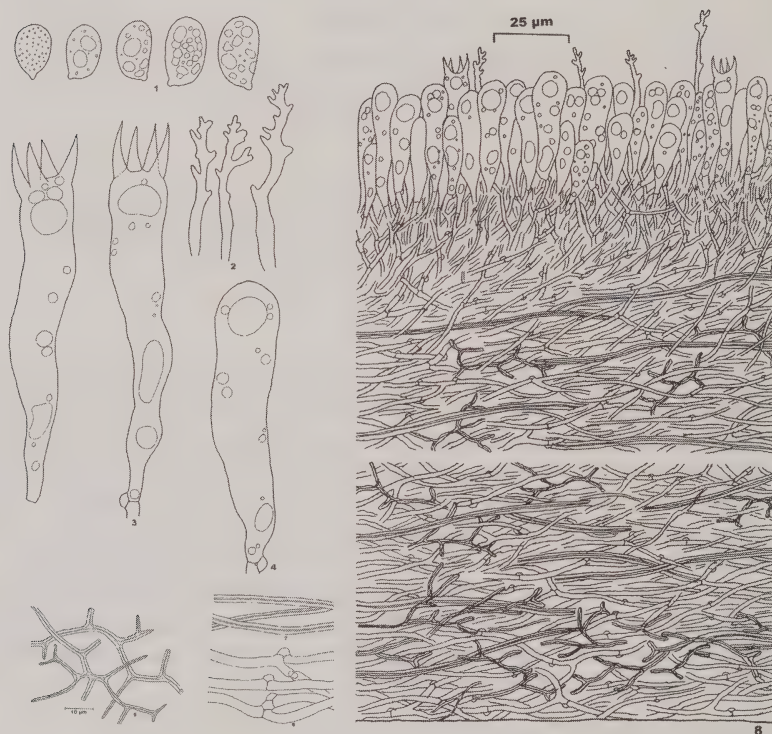
***Trimitiella* Dhingra, gen. nov.**

Fructificatio resupinata, adnata, effusa, membranaceus-ceracea, hymenio laevigata margo invicem in aresco; systema hyphale trimiticum; generative hyphis tenuitunicatum, nodoso-septatum; skeletal hyphis crassitunicatus, acyanophilous; binding hyphis ampleramosus, crassitunicatus; contextus constitutus de dense intricatus generative hyphis, skeletal hyphis, et binding hyphis; dendrohyphidia praesens; basidia clavata, fibuligera ad basis, 4-sterigmatibus; basidiosporae late ellipsoideae, tenuitunicatae, non-amyloideae, non-acyanophilae.

Type species: *Trimitiella indica* Dhingra sp. nov.

Etymology – *Trimitiella* refers to possession of a trimitic hyphal system.

Fruitbodies resupinate, adnate, effused, membranous-ceraceous; hymenial surface smooth, margin in turned on drying; hyphal system trimitic; generative hyphae clamped; skeletal hyphae thick-walled, acyanophilous; binding hyphae richly branched, thick-walled; context composed of densely interwoven generative hyphae, skeletal hyphae and binding hyphae; dendrohyphidia present; basidia clavate, with a basal clamp, 4-sterigmate; basidiospores broadly ellipsoid, smooth, thin-walled, non-amyloid, acyanophilous, with numerous oil drops.



Figs.1-8. Microscopic structures from basidiocarp of *Trimitiella indica*.

Clockwise from top left: Figs. 1. Basidiospores; 2. dendrohyphidia; 3. basidia; 4. basidiole;
5. binding hyphae; 6. generative hyphae; 7. skeletal hyphae;
8. vertical section of the basidiocarp.

***Trimitiella indica* Dhingra, sp. nov.**

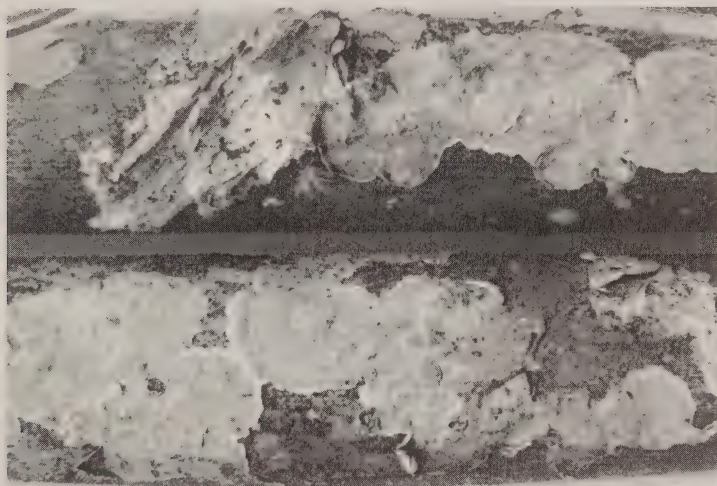
Figs. 1-9

Fructificatio resupinata, adnata, effusa, ad 360 µm crassa in sectione, membranaceo-ceracea; superficies hymenialis laevis ad farinaceus oculo armato, clarus-grisea ad grisea. Systema hyphale trimiticum; generative hyphae latum, tenuitunicatum, nodoso-septatum; skeletal hyphae crassitunicatus, acyanophilous; binding hyphae, ampleramosus,

crassitunicatus; contextus constitutus de dense intricatus generative hyphae, skeletal hyphae, et binding hyphae. Dendrohyphidia praesens. Basidii 55-70 x 10-12 μm , clavatus, subsinuatus, oleosus, 4-sterigmatibus. Basidiosporii 10-15 x 7-8.5 μm , late ellipsoideus, multiguttulatus.

Holotypus: India, Arunachal Pradesh, West Kameng, Bomdila, fere 3 Km ex Bomdila in Tawang, epi putrescens bamboo rameus, G.S. Dhingra 19722 (PAN, LY) Augusto 25, 1981.

Etymology – *indica* refers to the species occurrence in India



9

Fig.9. *Trimitiella indica* basidiocarp showing hymenial surface.

Fruitbody resupinate, adnate, effused, up to 360 μm thick in section, membranous, ceraceous; hymenial surface, smooth to farinose under lens, light grey to grey; margin loosely adnate, inturned on drying, thinning, irregular in outline, whitish. Hyphal system trimitic; generative hyphae branched, septate, clamped, thin- to somewhat thick-walled, 2-4 μm wide; skeletal hyphae up to 3 μm wide, mostly unbranched, aseptate without clamps, thick-walled, acyanophilous; binding hyphae up to 2.5 μm wide, richly branched, thick-walled; context composed of densely interwoven generative hyphae, skeletal hyphae and binding hyphae; binding hyphae comparatively more in the subiculum. Cystidia absent. Dendrohyphidia branched, thin-walled, basal part up to 3.5 μm wide. Basidia 55-70 x 10-12 μm , clavate, somewhat sinuous, with oily contents and a basal clamp, 4-sterigmate; sterigmata up to 12 μm long. Basidiospores 10-15 x 7-8.5 μm , broadly ellipsoid, smooth, thin-walled, non-amyloid, acyanophilous, with numerous oil drops. Spore print white.

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The lichen genus *Megalospora* in JavaLUDMILLA FITRI UNTARI¹

fitriuntari@yahoo.com

Herbarium Bogoriense

Jl. Juanda 22 Bogor-INDONESIA

Abstract—A taxonomic study of the genus *Megalospora* (Megalosporaceae) in Java was conducted based on morphological, anatomical, and chemical characters. Eight species of *Megalospora* with three subspecies and one variety are reported from Java. Three new species (*M. flavoexcipulata*, *M. javanica*, and *M. albomarginata*) and two new records [*M. campylospora* and *M. pruinata* subsp. *fusca*] are presented. Additional data are given for *M. atrorubicans* subsp. *atrorubicans*, *M. campylospora*, *M. sulphurata* var. *sulphurata*, *M. tuberculosa*, and *M. pruinata* subsp. *lamii*.

Keywords—taxonomy, Indonesia

Introduction

Megalospora is the biggest genus in the family Megalosporaceae. It is easily recognized by the crustose thallus, lecideine apothecia, large-sized and thick-walled spores, and oil droplets in the hymenium. A monograph is provided by Sipman (1983). For Java, Overeem & Overeem (1922) were the first to report a species of *Megalospora*, *M. tricolor* (Mont.) Overeem. However, according to Zahlbruckner (1926) this species is a synonym of *Lopadium leucoxanthum* (Spreng.) Zahlbr. (= *Brigantiaea leucoxantha* (Spreng.) R. Sant. & Hafellner). Later, Groenhart (1952, 1958) and Zahlbruckner (1956) reported seven species and a variety of *Megalospora*, namely *M. versicolor* (Fée) Zahlbr., *M. subvigilans* Zahlbr., *M. taitensis*, *M. marginiflexa* (Hook. f. & Taylor) Zahlbr., *M. atrorubicans*, *M. sulphurata*, *M. sulphurata* var. *phaeocheila*, and *M. flavidula*. However, *M. subvigilans*, *M. taitensis*, *M. sulphurata*, and *M. sulphurata* var. *phaeocheila* are synonyms of *M. sulphurata* var. *sulphurata*. *M. versicolor* is now regarded as a species of *Catinaria*, *Catinaria versicolor* (Fée) Sipman; *M. marginiflexa* is now regarded as a species of *Megaloblastenia*, *Megaloblastenia marginiflexa* (Hook. f. & Taylor) Sipman var. *marginiflexa*; and *M. flavidula* is a synonym of *M. atrorubicans* subsp. *atrorubicans*. In his worldwide *Megalospora*

¹Permanent Address: Faculty of Biology, Gadjah Mada University, Jln. Teknik Selatan Sekip Utara Yogyakarta-55281 INDONESIA.

monographic work, Sipman (1983) reported five species, three subspecies and a variety for Java namely *M. atrorubicans* subsp. *atrорubicans*, *M. coccodes* subsp. *nigricans* (Müll. Arg.) Sipman, *M. pruinata* subsp. *lamii*, *M. sulphurata* var. *sulphurata*, and *M. tuberculosa*.

The rich Javanese material of *Megalospora* deposited in the Herbarium Bogoriense numbering 240 specimens has never been subjected to critical examination and it has not been included in Sipman's monographic work. Those are used here for a study of the diversity of Javanese *Megalospora*, and to provide an identification key to its species. Surprisingly, several novelties were detected among these Javanese specimens.

Materials and methods

Materials of study

Herbarium specimens studied are those deposited in Herbarium Bogoriense Bogor (BO), numbering 240 sheets. Most specimens were collected before the year of 1953 and some at the year of 2001 in West Java. Since the specimen of Central and East Java was not available, field observations were made at some areas of Central and East Java (Kawasan Wisata Baturaden - Banyumas, Hutan Lindung Doro - Kab. Pekalongan Timur, and Hutan Lindung Guci - Kab. Pekalongan Barat). Nevertheless, *Megalospora* could not be found from the areas visited.

Method of investigation

External features of the specimens were studied under a stereoscopic microscope (20 - 40x), and the anatomical characters of apothecial and spore morphology were observed under a light microscope (40 - 1000x). Reagent test (=color test or spot test) was made on the medulla of apothecia and thallus with the following reagents i.e. calcium hypochloride (C), potassium hydroxide (K), and paraphenylenediamine (P). The color reaction of hymenia was observed after being immersed in iodine solution. In addition, lichen substances were also investigated with thin layer chromatography (TLC). The chromatogram was developed in solvent system B: n-hexane : diethyl ether : formic acid = 120:90:20 (Culberson & Johnson 1982). After evaporation of the solvent, the chromatogram is sprayed with 10% aqueous solution of sulphuric acid and heated at about 100 - 110 °C for 15 minutes and noted the color of spot and the R_f value. The chromatograms were also examined under UV light (254 Å and 350 Å) for examining the fluorescence of substances. The relation between the detected substances and the reagent test reaction is established by occasional spot color on the TLC spots.

The presence of zeorin could also be established by the presence of P+ and KC- (Miyawaki 1988). The presence of pannarin could be established by the

presence of P+ orange and KC-. Usnic acid is demonstrated by the P- and KC+ pale yellow and by the yellowish tinge of thallus (Kantvilas 1994, Sipman 1983).

The revision of the genus was based on the steps method described by Rifai (1976), Vogel (1987), and Maxted (1992): collecting the herbarium specimens of *Megalospora* of Java for a monographic treatment, making groups of specimens according to their overall resemblance, gathering the literatures, identifying and describing the available specimens, analysis the data, delimitating the taxa, making an identification key, studying the nomenclatures, and conducted a phylogenetic analysis to classify the relationships.

Results

Taxonomic treatment

- Megalospora* Meyen in Meyen & Flotow, Verh. Kaiserl. Nova Acta Acad. Leopold.-Carol. 19, Suppl.: 228 (1843)
 = *Heterothecium* sect. *Megalospora* (Meyen) Tuck., Synops. North. Amer. Lich. 2: 53 (1888)
 = *Lecidea* subgen. *Megalospora* (Meyen) Boistal, Nouv. Flore Lich., 2: 202 (1902). Type species: *Megalospora sulphurata* Meyen.

Thallus crustose, yellowish-, greenish-, grayish- or brownish gray, surface smooth to strongly rugulose, with small, irregular cracks, thin to thick, with or without cylindrical to coralloid isidia, with or without soredia, consisting of a cortical layer, an algal layer and a medullary layer (consisting of free hyphae); **apothecia** lecideine, sessile, adnate, plane to obconical, scattered, concave to flat with prominent margin when young, soon becoming flat to convex with more or less prominent margin; **disc** concave to flat when young soon becoming flat to slightly convex to very convex, glossy to dull, light brown to brown to dark brown to gray to grayish blue to black, and epruinose to pruinose; **margin** prominent or not, thin to thick, dull to glossy, cream to brown to dark brown to black, epruinose to pruinose; **epithecium** orange-brown to yellow-orange to bright dark orange, sometimes with granular substances at top layer, paraphyse tips branched and anastomosing; **hymenium** hyaline to pale brown to pale yellow, I+blue to I-, with wall of the asci and basal asci I+blue, with oil droplets; paraphyses parallel and without anastomoses; **subhymenium** hyaline to pale brown to pale yellow, I-; **hypothecium** brownish-, yellowish-, orange- or dark brown or black; **subhypothecium** clear or not; **excipulum** consisting of ectal and medullary excipulum; medullary excipulum arachnoid, often containing crystals of calcium oxalate; **ascus** cylindrical or slightly clavate, and slightly thicker at the apex (lecanora-type); **spores** bilocular-uniseptate, elongate, straight, single in an ascus; or bilocular-uniseptate, short, curved, more or less

reniform, (1-) 8 per ascus; or bacillar-plurilocular, elongate, straight, with (4-)5-11(-13) transverse septa, single in an ascus; or bacillar-plurilocular, elongate, curved, with (4-)5-11(-13) transverse septa, 2-5 per ascus; or muriform, ovoid, straight, single in each ascus. Spores have thick wall, which could be smooth or warted (after Sipman 1983).

Key to the Javanese species

- 1a. Spore bilocular 2
 - 1b. Spore bacillar-plurilocular 6
 - 2a. Spore straight, always single in an ascus 1. *M. atrorubicans*
 - 2b. Spore more or less curved, (1-)2-8 in each ascus 3
 - 3a. Epispore smooth, thallus containing usnic acid (P- and KC+ pale yellow) 4
 - 3b. Epispore warted, thallus containing pannarin (P+ orange and KC-) 5. *M. campylospora*
 - 4a. Hypothecium brown to black, excipulum yellow or brown to dark brown 5
 - 4b. Hypothecium bright orange, excipulum bright orange 2. *M. javanica*
 - 5a. Excipulum yellow, epithecium yellow, hypothecium brown to dark brown 3. *M. flavoexcipulata*
 - 5b. Excipulum brown to dark brown, epithecium orange-brown to brown, hypothecium dark brown to black 4. *M. sulphurata*
 - 6a. Spore single in an ascus, straight 6. *M. tuberculosa*
 - 6b. Spore (1-)4(-5) per ascus, more or less curved 7
 - 7a. Apothecia with grayish blue or cyaneous disc and black margin; epithecium olive green with blackish or dark olive green 7. *M. pruinata*
 - 7b. Apothecia with gray disc and white to cream margin; epithecium orange-brown 8. *M. albomarginata*
 - [7c.] Apothecia with pale brown to dark brown disc and pale yellowish margin; epithecium diffusely orange-brown or olivaceous brown *M. coccodes* *
- * *M. coccodes* subsp. *nigricans*, recorded by Sipman (1983), was not recognized among the specimens in Herbarium Bogoriense.

Taxonomic Descriptions

1. *Megalospora atrorubicans* (Nyl.) Zahlbr. Catal. Lich. Univ. 4: 86 (1927)

= *Lecidea marginiflexa* var. *atrorubicans* Nyl., Flora 49: 132 (1866). *Type*: Indonesia, Java, ad corticem arborum circa Toegoe (Puncak), alt 900 m (3000 ped.), Kurz 496, 17 February 1861 (H-Nylander, ISO in M).

= *Megalospora flavidula* Groenh., Reinwardtia 2: 398 (1954). *Type*: Indonesia, West Java, M. Gede, Cibodas, 1450 m on the branchlet of *Psidium cattleianum*, Groenh. 8746, 24 September 1952 (BO!).

Thallus pale green to grayish green, irregularly shaped, rather thin, nearly smooth with longitudinal cracks to very rugulose with little small irregular cracks, soredia and isidia absent; **chemistry**: usnic acid and zeorin; **apothecia** scattered, adnate, flat, orbicular to oblong and the large ones becoming irregularly shaped, up to 2 mm diam., c. 0.8 mm thick; **disc** concave when young, soon becoming slightly convex to very convex, occasionally flat in the juvenile and adult stage, dull to glossy, reddish brown to dark brown, and epruinose, occasionally scabrid; **margin** prominent, occasionally disappearing by age, thick, glossy, black, epruinose; **epithecium** orange-brown to yellow, 24-67 μm thick; **hymenium** yellow to hyaline, 193- 203(-286) μm high, I+ blue, subhymenium pale yellowish orange, 44-70 μm high; **hypothecium** dark brown, c. 124 μm high, K- to K+ black, P- to P+ black, subhypothecium clear to unclear, paler than hypothecium; **ectal excipulum** brown to black, K-, C-, in the outer layer of the ectal excipulum a layer of algae present.; **medullary excipulum** brown to whitish brown, K- to K+ black, P- to P+ black; **crystals of calcium oxalate** present in the medullary excipulum; **spores** single in the ascus, bilocular, and straight (atorubicans-type, cf. Sipman 1983: 44), 62-102 x 29-36 μm ; **spore wall** c. 3.3 μm thick; **epispore** c. 1.1 μm thick, smooth.

Note: *M. atrorubicans* has three subspecies, each with a different geographical distribution, namely *M. atrorubicans* (Nyl.) Zahlbr. subsp. *atorubicans*, *M. atrorubicans* subsp. *australis* Sipman, and *M. atrorubicans* subsp. *sendaiensis* (Räsänen) Sipman. In Java, only subspecies *atorubicans* occurs. This is characterized by the orange-brown color of the epithecium.

Distribution: This subspecies is distributed in the Hawaiian Islands, the Mascarene Islands, Indonesia, the Philippines, Papua New Guinea, and New Caledonia (Sipman 1983). In Java, it was found in Cibodas.

Habitat and ecology: In Java, this species was found in primary and secondary forest at altitudes ranging from 1400-1600 m. All collections were on bark.

SPECIMENS STUDIED – INDONESIA. WEST JAVA: Cibodas. GUNUNG GEDE (1400 m above sea level) – *Comm. Neervoort* 3508, 3510, 3550, 3601 (BO); *Comm. Neervoort & Schröter* 4479 (BO); *Comm. Schröter* 4005, 5258 (BO).

2. *Megalospora flavoexcipulata* Untari sp. nov.

(Leg, MB510308)

Thallus flavidus, crassus, laevis vel leviter rugulosus, leviter nitidus. Sorediis destitutus, verrucis 0.1-0.2 mm latis, verruculosa-inaequalis verruculis c. 0.05 mm latis et 0.2 mm altis vel isidiis coralliformibus cylindricis 0.1-0.2 mm latis et 0.1-0.5 mm altis. Apothecia ad 3 mm, raro 6 mm lata, adnata vel sat obconica. Discus persistenter concavus vel planus vel deinde convexus, nitidus vel opacus, spadiceus vel fuscus, epruinosis vel nonnumquam leviter pruinosis. Margo prominens, tenuis vel crassus, opacus vel nitidus, fuscus vel niger, dealbatus pruinosis. Epithecium vitellinum, (9-)14-57 μm crassum. Hymenium hyalinum, 106-286 μm crassum, I+ coerulescens in ascis et plerumque in parte basali hymenii. Subhymenium hyaline, (15-)20-98 μm crassum. Hypothecium fuscum vel brunneum, 44-

97 μm , subhypotheccio fusco, 24-63 μm . Excipulum flavum vel vitellinum, K- negativum, P- negativum, C+ flavus vel C- negativum. Crystalla calcii-oxalatici provisa. Basis apothecii (110-)197-683 μm latus. Sporae (2-)4-8(-12)-nae, bicellulares, leviter curvatae (typo sulphurata), magnitudine 41-103 x 19-45 μm . Septis pariete c. 2.2 μm crasso, episporio c. 1.1 μm crasso, laeve. Type: Indonesia, Java, Gegerbentang, 6 August 1949, Comm. Neervoort 1351 (Holotypus: BO!).

Thallus grayish green to yellowish green, thick, nearly smooth to rugulose with irregular cracks, with 0.1-0.2 mm diam. warts, and 0.05-0.2 mm diam. wartlets, with cylindrical and coralloid isidia measuring 0.1-0.2 x 0.1-0.5 mm, epruinose, slightly glossy, soredia absent; **chemistry**: usnic acid and zeorin; **apothecia** scattered to dense, sessile to adnate, somewhat obconical, orbicular to oblong and the large ones becoming reniform to irregularly shaped, up to 3 mm diam., rarely up to 6 mm diam., (186-)405-975 μm μm thick; **disc** concave to flat when young, the large ones becoming flat to slightly convex, dull to slightly glossy, light brown to dark brown, epruinose but occasionally brownish pruinose; **margin** prominent, thin to thick, dull to glossy, brown to black sometimes typically black at the upper edge and light brown to pale fawn at the side edge and below, epruinose but occasionally covered with whitish pruina; **epithecium** yellow or with a tinge of orange, occasionally with yellow granules on top, (9-)14-57 μm thick; **hymenium** hyaline to greenish yellow to yellowish orange, 106-286 μm high, I+blue to I-, I+blue in the asci, K+yellow, subhymenium hyaline to brownish yellow to yellowish orange, (15-)20-98 μm high, I-; **hypotheccium** brown to dark brown, 44-97(-254) μm thick, and subhypotheccium brown, occasionally unclear, 24-63(-117) μm thick; **excipulum** yellow to yellow with a tinge of orange, K-, C-, P-; **crystals of calcium oxalate** present in ectal and medullary excipulum; **apothecium base** (101)-197-683 μm ; **spores** (2-)4-8 per ascus, bicellular, and usually curved (sulphurata-type, cf. Sipman 1983: 44), 41-103 x 19-45 μm ; **spore wall** c. 2.2 μm thick; **episporium** c. 1.1 μm thick, smooth.

Note: The specific epithet refers to the fact that the new taxon is easily recognized by the yellow color of its excipulum and epithecium. In addition, this species deviates from *M. sulphurata* by a tendency of having a smooth thallus and being never found overgrowing mosses.

Distribution: This species was found in Cibodas, Gunung Gede, Gegerbentang, and Sinapeuh.

Habitat and ecology: In Java, this species was found in primary and secondary forest at altitudes ranging from 1400 - 1600 m. It is found on bark.

SPECIMENS STUDIED – INDONESIA. WEST JAVA: Cibodas. GUNUNG GEDE (1400 m above sea level) – C. van Woerden 1136, s.n., s.n. (BO); K.B. Boedijn 1460 (BO); Drs. v. Leeuwen Reijnvaan 1213, 12142 (BO); Comm. Neervoort 3555, 3862 (BO); Comm. Schröter 4367, 5020, 5359, 5412, 6319 (BO); Comm. Neervoort & Schröter 4481 (BO); **Rarahan Java** – Groenh. 8614 (BO); **Gegerbentang** – Comm. Neervoort 1351, 1404 (BO); **Rawa Gede** – Comm. Schröter 5069 (BO)

3. *Megalospora javanica* Untari sp. nov.

(Leg, MB510309)

Thallus flavescenti-fuscus vel cinerascens-fuscus, crassus, laevis vel paulo rugulosus, nitidus. Sorediis isidiisque destitutus, sed aliquando veruculosa-inaequalis, verrucis c. 0.25 mm latis. Apothecia ad 4 mm lata. Discus persistenter concavus vel deinde planus vel convexus, opacus vel nitidus, porphyreus vel niger, epruinosis. Margo prominens, crassus vel tenuis, opacus vel nitidus, albescens vel niger, epruinosis. Epithecium ferrugineum, c. 52 μ m crassum. Hymenium hyalinum, 249-260 μ m crassum, I+ coeruleus. Subhymenium vitellinum, 78-104 μ m crassum. Hypothecium croceum, 78-166 μ m, K+ flavescens, C- negativum, P+ sanguineum; subhypothecium croceum, K+ flavescens, C- negativum, P+ sanguineum. Excipulum croceum, K+ flavescens vel K- negativum, C- negativum, P+ sanguineum, crystallis calcii-oxalaticis provisum. Basis apothecii 487-537(-750) μ m latus. Sporae 4-6-nae bicellulares, leviter curvatae, (typo sulphurata), magnitudine 59-70 x 19-30 μ m, pariete 2.2-3.3 μ m crasso, episporio c. 1.1 μ m crasso, laeve.. Type: Indonesia, Java, Cibodas, 10 May 1950, Comm. Schröter 5347. (Holotypus: BO!).

Thallus yellowish brown to grayish brown, thick, smooth to slightly rugulose with small, irregular cracks, occasionally with c. 0.25 mm diam. warts, glossy, soredia and isidia absent; **chemistry**: usnic acid and zeorin, **apothecia** scattered, sessile, orbicular and the large ones becoming lobed or reniform, up to 4 mm diam., (848-)1275-1370 μ m thick; **disc** concave when young, soon becoming flat to convex, dull to glossy, reddish brown to black, and epruinose; **margin** prominent, thick but in large apothecia becoming thin, glossy to dull, black to cream, epruinose; **epithecium** orange-brown, c. 52 μ m thick; **hymenium** hyaline or pale, 249-260 μ m high, I+blue; **subhymenium** reddish yellow, 78-104 μ m high; **hypothecium** bright orange, 78-166 μ m thick, K+ yellow, C-, P+ red; **subhypothecium** bright orange, K+ yellow, C-, P+ red; **excipulum** bright orange, K+ yellow or K-, C-, P+ red; **crystals of calcium oxalate** present in medullary exciple; **apothecium base** 487-537 (-750) μ m; **spores** 4-6 per ascus, bicellular, and usually curved (sulphurata-type, cf. Sipman 1983: 44), 59-70 x 19-30 μ m; **spore wall** 2.2-3.3 μ m thick; **episporium** 1.1 μ m thick, smooth.

Note: The specific epithet refers to the collecting locality of this species. This species is characterized by the bright orange color of the hypothecium and excipulum, and the mostly spores found are the wide spores.

Distribution: This species was found in Cibodas and Sinapeuh.

Habitat and ecology: In Java, this species was found in primary and secondary forest at altitudes ranging from 1400-1600 m. This species was growing on bark.

SPECIMENS STUDIED – INDONESIA. WEST JAVA: Cibodas. GUNUNG GEDE (1400 m above sea level) – K.B. Boedijn 1417 (BO); Comm. Schröter 4203, 5016, 4203, 5347, 5360 (BO); Comm. Neervoort & Schröter 4897, 4850 (BO); Comm. Neervoort 3714, 3514 (BO); Sinapeuh – Comm. Schröter 5136 (BO).

4. *Megalospora sulphurata* Meyen in Meyen & Flotow, Verh. Kaiserl. Nova Acta Acad. Leopold.-Carol. 19, Suppl.: 228 (1843). *Type*: Philippines, "crescit in lignis putridis Manillae", F. J. F. Meyen, IX-X. 1841 (G isotype?).

Catillaria sulphurata var. *phaeocheila* Vain., Annal. Acad. Sci. Fenn., ser. A, 15, no. 6: 104 (1921) = *Megalospora sulphurata* var. *phaeocheila* (Vain.) Zahlbr., Catal. Lich. Univ. 4: 91 (1927).

Biatora taitensis Mont., Ann. Sci. Nat., Bot., ser. 3, 10: 126 (1848) = *Heterothecium taitense* (Mont.) Mont. & Bosch, in Junghuhn, Plant. Junghuhn., fasc 4: 462 (1855) = *Blastenia taitensis* (Mont.) Trevis., Linnaea 28: 290 (1856) = *Psorothecium taitense* (Mont.) A. Massal., Atti I. R. Istit. Veneto, ser. 3, 5: 261 (1860) = *Lecidea taitensis* (Mont.) Nyl., Ann. Sci. Nat., Bot., ser. 4, 19: 243 (1863) = *Patellaria taitensis* (Mont.) Müll. Arg., Flora 65: 330 (1882) = *Megalospora taitensis* (Mont.) Overeem, Bull. Jard. Bot. Buitenzorg, ser. 3, 4: 120 (1922). *Type*: Tahiti. J. Léprie 33 (P, iso H). (Teste Sipman 1983).

Patellaria subvigilans Müll. Arg., Flora 65: 329 (1882) = *Biatorina subvigilans* (Müll. Arg.) Hellb., Bih. Kgl. Svensk. Vetensk.-Akad. Handl. 21, afd. 3, 13: 109 (1896) = *Megalospora subvigilans* (Müll. Arg.) Zahlbr. in Reehinger, Denkschr. math.-naturw. Classe K. Ak.-ad. Wiss. Wien 81: 251 (1908). *Type*: „Frequens in insula Java (in hb. saepe cum Patell. taitensi commixta)“, Java, 350/37, upper right specimen (G Lectotype nov., Iso L). (Teste Sipman 1983).

Thallus pale gray to greenish gray to yellowish green, irregularly shaped, rather thin to rather thick, smooth to very rugulose with irregular, small cracks or with longitudinal, regular cracks, dull to glossy to very glossy, epruinose, occasionally warted or verruculose with 0.1-0.5 mm diam. wartlets, with or without soredia and isidia; **isidia** cylindrical to coralloid, 0.3-0.5 mm long, 0.15-0.3 mm thick; **soredia** granular, c. 60 µm; **chemistry**: usnic acid and zeorin; **apothecia** scattered to dense, sessile, adnate, somewhat obconical, orbicular to oblong and the large ones becoming lobed or irregularly shaped, up to 3 mm diam. when adult, rarely up to 5 mm, 575-975 µm thick; **disc** concave to flat, in large apothecia flat to very convex, dull to glossy, reddish black when young and black when adult or brown to black, and epruinose to whitish pruinose, occasionally scabrid; **margin** prominent, thick, occasionally becoming thin in large apothecia, glossy to dull, light brown to brown (occasionally with a dark brown to black rim around the disc) to dark brown to black or sometimes typically black at the upper edge (adjacent to the disc) and light brown at the side and below, epruinose to grayish pruinose; **epithecium** orange-brown to yellowish orange-brown to brown, (12-)19-37(-73) µm thick; **hymenium** hyaline and with diffuse orange to brownish orange spots, 176-375 µm high, I+ blue or I- with wall of the asci and basal asci I+blue; **subhymenium** hyaline (darker) to light yellow or yellowish orange, (15-)29-63(-111) µm; **hypothecium** olive green to dark brown to black, (41-)97-114(-244) µm; **subhypothecium** usually unclear, occasionally clear, yellowish brown occasionally diffusely olive green to brown to black, 29-58 µm; **excipulum** brown to dark brown or occasionally orange-yellow with diffuse olive green, K+ yellow to K-, C- to C+ yellow at

the medullary excipulum, P– to P+ brown-orange; crystals of calcium oxalate present in the ectal and medullary excipulum; apothecium base (110-)215-507(-946) μm wide; spores (1-)2-6 per ascus, bicellular, and usually curved (sulphurata-type, cf. Sipman 1983: 44), 44-94(-101) $\times$ (17-)24-38(-41) μm ; spore wall 2.2-3.3 μm thick; epispore c. 1.1 μm thick, smooth.

Note: *M. sulphurata* has two varieties, which coincide with their geographical distribution: *M. sulphurata* var. *sulphurata* (distributed pantropically) and *M. sulphurata* var. *nigricans* (distributed neotropically). Besides by the geographical distribution, var. *sulphurata* also deviates from var. *nigricans* by the orange-brown color of epithecium. In Java, only var. *sulphurata* occurs.

The Javanese specimens of var. *sulphurata* show a wide variation in thallus morphology, size and apothecium morphology, size of spores, size of the hymenium, pigmentation of the ectal and medullary excipulum and hypothecium, and apothecium chemistry. Since the variability of these characters sometimes could be seen within a single thallus, they do not permit separation of further taxa.

Zahlbruckner (1956) reported *M. subvigilans*, *M. taitensis*, *M. sulphurata*, and *M. sulphurata* var. *phaeoecheila* from Java. According to Sipman (1983) these are the synonyms of *M. sulphurata* var. *sulphurata*.

Distribution: *M. sulphurata* Meyen is one of the most widespread species and var. *sulphurata* is distributed in Hawaiian Islands, Tahiti, Samoa, Brazil, Mexico, Jamaica, Tanzania, Mascarene Islands, Ascension, India, Sri Lanka, Malaya, Sabah, Indonesia, Philippines, Japan, Taiwan, Papua New Guinea, Australia, and New Caledonia (Sipman 1983). In Java, this species is also very widely distributed as compared to other species, since it was found in Cibodas, Gunung Gede, Gunung Papandayan, Gegerbentang, Mountain Tjiboga, Rawa Gede, Rawa Panjang, and Mountain Patuha-Telaga Patengan.

Habitat and ecology: In Java, *M. sulphurata* is abundant in rain forest at altitudes of 1000-2000 m above sea level.

SPECIMENS STUDIED – INDONESIA. WEST JAVA: Cibodas. GUNUNG GEDE (1400 m above sea level) – C.A.D Overeem 90, 208, s.n. (BO); Res. v. Leeuwen Reijnvaan 5673, 5695, 12072, 12137, s.n. (BO); C.A.D Overeem & Dakkus. A. Bruggeman 99, 150, s.n. (BO); G. Kjellberg 102 (BO); C.L.L.H van Woerden s.n. (BO); Groenhardt 8714 (BO); Comm. Neervoort 14, 139, 3133, 3132, 3331, 3509, 3555, 3566, 3568, 3581, 3596, 3597, 3607; 3618, 3769, 3776, 3795, 3871, 3906, 3920, 3928, 3954, 3955, 3959 (BO!); Comm. Schröter 4000, 4004, 4043, 4046, 4106, 4111, 4162, 4191, 4206, 4213, 4229, 4251, 4252, 4289, 4298, 4377, 4404, 5015, 5018, 5019, 5021, 5023, 5025, 5026, 5027, 5037, 5283, 5316, 5336, 5348, 5359, 6319, 5420 (BO); Comm. Neervoort & Schröter 4471, 4482, 4491, 4495, 4496, 4500, 4534, 4569, 4571, 4595, 4598, 4648, 4656, 4698, 4705, 4711, 4784, 4785, 4849, 4869, 4872, 4896, 4898 (BO); K.B. Boedijn 1419, 1423, 1458 (BO); Gegerbentang – Comm. Neervoort 976, 981, 1048, 1054, 1238, 1404, 1408, 3009, 3108, 3260, 3286, 3287 (BO); Comm. Schröter 4962, 4974 (BO); Mountain Patuha. TELAGA PATENGAN (1600

m above sea level) – *M.A. Donk 14* (BO); **Mountain Tjiboga** – *Comm. Neervoort 1878* (BO); **Rawa Gede**, *Comm. Schröter 5077* (BO); **Rawa Pandjang** –, *Comm. Schröter 5097, 5100, 5210, 5216* (BO); **Sinapeuh** – *Comm. Schröter 5113, 5114, 5115* (BO).

5. *Megalospora campylospora* (Stirt.) Sipman, *Bibliotheca Lichenologica* 18:114 (1983)

≡ *Lecidea campylospora* Stirt., *Transact. Proc. New Zealand Inst.* 6: 238 (1873). **Type:** New Zealand, Kaka Hill, *J. Buchanan 11*, December 1871 (WELT).

Thallus brownish gray with irregularly shaped, rather thick, very rugulose with little cracks, glossy, epruinose; **soredia and isidia** absent but a part of the thallus verruculose; **chemistry:** pannarin and zeorin; **apothecia** scattered, sessile, orbicular or oblong and the large ones becoming lobed to reniform to irregularly shaped, up to 3 mm diam., 663-790 µm thick; **disc** scabrid, flat when young, soon becoming convex, dull, dark brown, epruinose; **margin** prominent, thin, dull, light brown to cream, epruinose; **epithecium** orange-brown, (19-)27-38 µm thick; **hymenium** hyaline, 106-276 µm high, I+ blue; **subhymenium** yellowish brown, 26-42 µm, I–; **hypothecium** brownish yellow, 78-104 µm, K+ hyaline, C+ orange; **subhypothecium** brownish yellow, K+ hyaline; **ectal excipulum** yellowish orange, K+ hyaline, P+ brown, C+ orange; **medullary excipulum** white below the hypothecium, K+ hyaline; **crystals of calcium oxalate** absent; **apothecium base** 35-400 µm wide; **spores** 4-6 per ascus, bilocular, usually curved (sulphurata-type, cf. Sipman 1983: 44), 46-62 x 24-28 µm; **spore wall** c. 2.2 µm thick; **episore** c. 1.1 µm thick, warted.

Note: The available specimen deviates from Sipman's description (1983) by the epruinose apothecium discs and by the light brown to cream color of the apothecium margins. As more collections become available, it may prove worthy of further study and of a separate taxonomic status.

Distribution: New Zealand, Tasmania, Lord Howe Island, and Indonesia (Java: Cibodas).

Habitat and ecology: The only specimen available was collected at an altitude of average 1400 m. This species was growing on bark.

SPECIMENS STUDIED – INDONESIA. WEST JAVA: Cibodas. **GUNUNG GEDE** (1400 m above sea level) – *Comm. Neervoort 3862* (BO).

6. *Megalospora tuberculosa* (Fée) Sipman, *Bibliotheca Lichenologica* 18: 156 (1983).

≡ *Lecidea tuberculosa* Fée, *Essai sur les Cryptog. des Ecorc. exotiques* Offic. Paris p. 107 (1824) **Type:** Ad corticem cinchonarum (in America, herb. Fée, Types no. 268, larger card, larger piece of two in a row (G).

Thallus grayish green to yellowish green to brownish green, irregularly shaped, rather thick, smooth to rugulose with irregular small cracks to horizontal cracks but occasionally little cracks, slightly glossy to very glossy; **soredia and**

isidia absent; **chemistry**: usnic acid and zeorin; **apothecia** sessile, sometimes obconical and much protruding, orbicular or oblong and the large ones becoming lobed to reniform to irregularly shaped, up to 2.5 mm diam., 223-702 μm thick; **disc** concave to flat, in large apothecia slightly convex, dull to slightly glossy to glossy, brown to dark brown to black, epruinose (in *Neervoort* 3604 with whitish pruina), often scabrid; **margin** more or less prominent, thin to thick, glossy to very glossy, black or sometimes typically black at the upper edge and light brown at the side and below, epruinose to slightly pruinose; **epithecium** yellowish brown to brown, (12-)29-52(-73) μm thick, K- (except in *Schröter* 4230 K+ orange-brown); **hymenium** hyaline to green yellowish, (130-)187-219(-231) μm high, I+ blue; **subhymenium** hyaline to green yellow, (39-)41-73 μm ; **hypothecium** pale brown to brown to dark brown, (22-)52-94(-115) μm ; **subhypothecium** unclear, or occasionally greenish yellow or paler than the hypothecium to reddish brown, 19-62 μm thick, K-, P-, C-; **excipulum** dark brown to black, K- to K+red, P-, C- to C+yellow; **crystals of calcium oxalate** present in the ectal and medullary excipulum; **apothecium base** 119-537 μm wide; **spores** straight, bacillar-pluriseptate, (tuberculosa-type, cf. Sipman 1983: 44), single in an ascus, 89-137(-169) x 22-52 μm , (3-)5-11(-13) -celled; **spore wall** c. 2.2 μm thick; **epispore** 1.1 μm thick, smooth.

Note: The color of thallus of the available specimens is very variable. The specimens lack soredia, which occur frequently elsewhere. Moreover, some specimens show a brown epithecium, differing from what occurs elsewhere.

Distribution: *M. tuberculosa* is distributed widely in the world: Cuba, Bolivia, Brazil, Ecuador, Burundi, Colombia, Panama, Peru, Costa Rica, Jamaica, Mexico, Rwanda, Madagascar, Mascarene Islands, Germany, Portugal, France, India, Indonesia, Sarawak, Papua New Guinea, Philippines, Japan, and China (Sipman 1983). In Java, this species was found in Cibodas and Gegerbentang.

Habitat and ecology: This species inhabits mostly mountains at an altitude of 1000 to 2000 m.

SPECIMENS STUDIED – **INDONESIA. WEST JAVA:** Cibodas. GUNUNG GEDE (1400 m above sea level) – *Comm. Neervoort* 3045, 3537, 3604, 3742, 3776 (BO); *Comm. Schröter* 4201, 4223, 4230, 4364, 4369, 4373, 5288, 5351, 5361, 5409 (BO); *Comm. Neervoort & Schröter* 4524, 4556, 4639, 4654, 4717, 4780, 4871, 4888, 4903 (BO); **Gegerbentang** – *Comm. Neervoort* 1336 (BO); *Comm. Schröter* 4977, 4983, 4986, 4988, 4989 (BO).

7. *Megalospora albomarginata* Untari sp. nov.

(Leg. MB510310)

Thallus cinerascens, tenuis, sat laevis, nitidus, obsitus muscis aut cortice arborum. Sorediis isidiisque destitutus, sed aliquando veruculosa-inaequalis, verruculis c. 0.5 mm latis et 0.5 mm altis. Apothecia c. 3.5 mm lata, adnata vel sat obconica, dispersa. Discus planus, leviter nitidus, cineraceus aut griseus, epruinosis, in parvulis apotheciis albidus pruinosis circum disco, scabridus. Margo prominens, crassus, opacus vel nitidus, albidus vel albescens, epruinosis. Epithecium ferrugineum vel pallido-rufum, 16 - 22 μm crassum.

Hymenium hyalinum, 230-297 μm crassum, I+ coerulescens in ascis et plerumque in parte basali hymenii. Subhymenium sulphureum, 52-68 μm crassum. Hypothecium brunneum vel niger, 104-156 μm crassum, subhypothecio apertum. Excipulum spadiceum, K- negativum, P- negativum, C- negativum. Crystalla calcii-oxalatici provisa. Basis apothecii 650-732 μm latus. Sporae 3-6 nae, bacillares, leviter curvatae (typo coccodes), e 8-13 loculis compositae, 61-83 x 19-27 μm , septis tenuibus et pariete c. 1.1 μm crasso, episporio tenuissimo, laeve.

Type: Indonesia, Java, Cibodas, 1400 m above sea level, 18 April 1950, Comm. Neervoort & Comm. Schröter 4545 (Holotypus: BO!).

Thallus gray, thin, nearly smooth with small irregular cracks, glossy; **soredia** and **isidia** absent but occasionally tubercles present, c. 0.5 mm wide and c. 0.5 mm high; **chemistry**: pannarin and zeorin; **apothecia** adnate, somewhat obconical, scattered, orbicular to oblong, up to 3.5 mm diam; **disc** flat, even in small and large apothecia, slightly glossy, gray to dark gray (Neervoort & Schröter 4643 has a black rim around the disc), epruinose, the young apothecia with a whitish pruinose rim around the disc, scabrid; **margin** prominent, thick, dull to glossy, white to cream, epruinose; **epithecium** orange-brown to brown, 16-22 μm thick; **hymenium** hyaline, 230-297 μm high, I+ bluish-green; **subhymenium** yellowish, 52-68 μm high; **hypothecium** dark brown to black, 10-156 μm thick; **subhypothecium** unclear; **ectal excipulum** pale brown, K-, P-, C-; **medullary excipulum** brown, K-, P-, C-; **crystals of calcium oxalate** present in the ectal and medullary excipulum; **apothecium base** 650-732 μm wide; **spores** bacillar-pluriseptate, straight and occasionally slightly curved, with thin septa (coccodes-type, cf. Sipman 1983: 44), 3 - 6 per ascus, 61-83 x 19-27 μm , 7-12-septate; **spore wall** c. 1.1 μm thick; **episporium** unclear, smooth.

Note: The specific epithet refers to the fact that this new taxon is easily recognized by the white to cream margin and gray to dark gray disc of the apothecia.

Distribution: The present species is known from Cibodas, Gunung Gede, Cibereum, and Sinapeuh.

Habitat and ecology: The present species is found at altitudes ranging from 1400 to 2000 m, on trees in woods.

SPECIMENS STUDIED – INDONESIA. WEST JAVA: Cibodas. GUNUNG GEDE (1400 m above sea level) – C.L.L.H. van Woerden s.n. (BO); Comm. Neervoort 3827, 3901 (BO); Comm. Schröter 4204, 4220, 4222 (BO); Comm. Neervoort & Schröter 4528, 4545, 4643 (BO); **Sinapeuh** – Comm. Schröter 5119 (BO); **Cibereum** – Groenhardt 8641 (BO).

8. *Megalospora pruinata* (Müll. Arg.) Sipman, Bibliotheca Lichenologica 18: 145 (1983).
= *Patellaria pruinata* Müll. Arg., Engler Bot. Jahrb. 20:273 (1894) **Type:** Tanzania, Usambara, Holst 1411 (G)

Thallus whitish (pale gray) to gray, thin, epruinose; **soredia** and **isidia** absent; **chemistry**: pannarin and zeorin; **apothecia** dense, sessile, orbicular to oblong,

up to 2.5 mm diam; **disc** surface of apothecia with a bluish color; **spores** bacillar-pluriseptate, straight to slightly curved with thin septa (coccodes-type, cf. Sipman 1983: 44), (1-)4(-5) per ascus.

Key to subspecies of *M. pruinata*

- 1a. Apothecia with grayish blue disc and black margin, epithecium dark olive green, epruinose, spores more consistently curved
.....a. *M. pruinata* subsp. *fusca*
 - 1b. Apothecia with cyaneus to atro-cyaneus disc and black margin, epithecium olive green blackish, with bluish-white pruina, spores straight to curved
..... b. *M. pruinata* subsp. *lamii*
 - [1c.] Apothecia with bluish disc and brown to dark brown to black margin, epithecium brown, epruinose, spores straight to curved
..... *M. pruinata* subsp. *pruinata**
- **M. pruinata* subsp. *pruinata* was not recognized among the specimens in Herbarium Bogoriense.

8a. *M. pruinata* subsp. *fusca* Sipman, Bibliotheca Lichenologica 18:141 (1983). *Type*: Papua New Guinea, prov. Chimbu, Pindaunde valley near Mount Wilhelm, in mossy dwarfforest on NE-facing slope along lake Piunde, altitude 3550 m, *H Sipman 15834*, 14. VIII. 1981 (U, ISO in UPNG).

Thallus gray, thin, nearly smooth with irregular cracks, glossy, epruinose; **soredia** and **isidia** absent; **chemistry**: pannarin and zeorin; **apothecia** dense, sessile, orbicular to oblong, up to 2.2 mm diam., 624-663 µm thick; **disc** concave, in large apothecia flat, dull, grayish blue and when young covered by bluish pruina; **margin** prominent, thick, glossy, black, and covered by white-bluish pruina; **epithecium** dark olive-green, 19-30 µm thick; **hymenium** hyaline, colorless, 240-256 µm high, I+blue; **subhymenium** yellow orange, 32-45 µm high; **hypothecium** orange-brown, 89-100 µm thick; **subhypothecium** orange brown, paler than hypothecium, 24-35 µm thick; **excipulum** ferrugineous (yellowish brown-orange), K-, P+ orange; **crystals of calcium oxalate** present in the ectal and medullary excipulum; **apothecium base** 399-439 µm wide; **spores** bacillar-pluriseptate, slightly curved, with thin septa (coccodes-type, cf. Sipman 1983: 44), 1(-4) per ascus, 119-124 x 38-42 µm, (6-)9-13-celled; **spore wall** c. 2.2 µm thick; **episore** 1.1 µm thick, smooth.

Note: The available specimen deviates from Sipman's description (1983) by the grayish blue color of the disc.

Distribution: Papua New Guinea, Indonesia (Java: Cibodas).

Habitat and ecology: The only specimen of this subspecies available was collected at an altitude of average 1400 m. The present subspecies was growing on bark.

SPECIMENS STUDIED – INDONESIA. WEST JAVA: Cibodas. GUNUNG GEDE (1400 m above sea level) – *Comm. Neervoort & Schröter 4640* (BO).

8b. *M. pruinata* subsp. *lamii* (Groenh.) Sipman, Bibliotheca Lichenologica 18: 143 (1983).

= *Bombyliospora lamii* Groenh., Blumea suppl. 4: 110 (1958) **Type:** Indonesia, West Java, Cibodas, Mt. Gede, in rain forest, on *Turpinia pomifera*, 4 m high, exposed, alt. 1400 m, Nurta & Madrodji in coll. van Oostroom 14340 (L).

Thallus whitish (pale gray), thin, very rugulose, very glossy, hypothallus blackish, epruinose; **soredia and isidia** absent; **chemistry:** pannarin and zeorin; **apothecia** dense, sessile, orbicular to oblong, up to 2.5 mm diam., 663–702 μm thick; **disc** concave, in large apothecia becoming flat, dull, cyaneous (very dark blue) to atro-cyaneous (black) and covered by bluish-white pruina; **margin** prominent, thick, glossy, black and around the disc covered by bluish-white pruina; **epithecium** olive-green with diffuse blackish, 36–58 μm thick; **hymenium** hyaline, colorless, 270–302 μm high, I+blue; **subhymenium** yellow- orange, 36–58 μm high; **hypothecium** dark brown, 44–55 μm thick, **subhypothecium** dark brown, 32–43 μm thick; **excipulum** brown-orange with a thin darker ectal layer and often covered by an extended attachment layer containing algae, K–, P–, C–; **crystals of calcium oxalate** present in the ectal and medullary excipulum; **apothecium base** 327–349 μm wide; **spores** bacillar-pluriseptate, straight to slightly curved, with thin septa (coccodes-type, cf. Sipman 1983: 44), (1–4(–5) per ascus, 61–100 x 27–38 μm , (4–)7–8-celled; **spore wall** c. 2.2 μm thick; **epispore** 1.1 μm thick, smooth.

Distribution: Sabah, Indonesia (Java: Cibodas)

SPECIMENS STUDIED – INDONESIA. WEST JAVA: Cibodas. GUNUNG GEDE (1400 m above sea level) – K.B. Boedijn 1458 A (BO).

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Albatrellus yunnanensis, a new species from China

HUAN-DI ZHENG

hdzhhb@yahoo.com.cn; hdzhenghb@126.com

Kunming Institute of Botany, Chinese Academy of Sciences

Kunming, Yunnan, 650204, P. R. China

Graduate School of the Chinese Academy of Sciences

Beijing, 100039, P. R. China

PEI-GUI LIU *

pgliu@mail.kib.ac.cn

Kunming Institute of Botany, Chinese Academy of Sciences

Kunming, Yunnan, 650204, P. R. China

Abstract—*Albatrellus yunnanensis*, a new species is described and illustrated herein. It is characterized by yellowish to yellowish ochraceous pileus, nearly glabrous or with minute scales, cream tube layer, white context, clamped generative hyphae and non-amyloid, relatively large basidiospores. Differences and similarities between the new species and related species are discussed and a key to *Albatrellus* species known from China is given. *A. mexicanus* is treated as a synonym of *Polyporoletus sublividus* after re-studying its holotype.

Key words—*Albatrellaceae*, taxonomy

Introduction

Up to now, approximately seven species of the genus *Albatrellus* Gray have been recorded from the markets of southwestern China (Liu et al. 1992, Zhang 1999, Wang & Liu 2002, Wang et al. 2004, Zheng et al. 2004). Among them, *A. confluens* (Alb. & Schwein.) Kotl. & Pouzar, *A. dispansus* (Lloyd) Canf. & Gilb. and *A. ellisii* (Berk.) Pouzar are the most common ones. While studying the specimens of *Albatrellus*, we found that four specimens bought from Nanhua county (Yunnan Province) wild mushroom market could not be assigned to any known *Albatrellus* species. The supermarket specimens local market specimens are described, illustrated, and proposed as a new species. Differences and similarities between the new species and closely related species are discussed, and a key to *Albatrellus* species known from China is given.

* corresponding author

Materials and methods

All specimens examined are preserved in the Cryptogamic Herbarium, Kunming Institute of Botany, Chinese Academy of Sciences (HKAS).

The macroscopic characters were recorded from fresh specimens or taken from field notes accompany the specimens. Microscopic examinations were carried out on dry specimens, mounting hand cut sections of basidiocarps in 5–10% KOH, Congo red and Melzer's reagent.

Dimensions for basidiospores are given using notation of form (a–) b–c (–d). The range b–c contains a minimum of 90% of the measured values. Extreme values—e.g., a or d—are given in parentheses. Q is used mean 'length/width ratio' of basidiospores in side view, Q (in bold face) means average Q of all basidiospores measured $\pm$ sample standard deviation (Yang & Zhang 2003).

Taxonomic description

Albatrellus yunnanensis H.D. Zheng & P.G. Liu, sp. nov.

Figs. 1–7

MYCOBANK # 510285

*Fructificatio annua, stipitata, singularis vel confluentis. Pilei circularis vel reniformis, subplano vel centro depressus, olivaceus flavus usque ad obscure luteae ochraceae suffusus, 5–20 cm lato, glabrous ad squamulosae. Stipite solido, bulboso, centrali, excentrico vel laterali, 4–7 $\times$ 2.5–7 cm. Tubuli decurrentibus, cremeibus, 1–3 per mm, angulatis. Systema hypharum monomiticum, hyphae generatoriae hyalinae fibulatae. Sporae ellipsoideae to subglobae, hyalinae, laeves, nonamyloidea, (7.5–) 7.8–9.9 (–11.8) $\times$ (5.3–) 6.0–7.5 (–8.0) μ m (182 spores), [Q = (1.13–) 1.21–1.42 (–1.53), **Q** = 1.31 $\pm$ 0.07]. Basidia clavata, 4-sterigmatica, 25–48 $\times$ 10–15 μ m.*

Holotypus: CHINA, Yunnan Prov.: Nanhua county wild mushroom market, 9 Sept. 2000, leg. Xiang-Hua Wang 1154 (HKAS 37107)

Etymology: "yunnanensis" referring to Yunnan, where the holotype was collected.

Basidiocarp annual, stipitate, medium to large, single or confluent.

Pileus circular to kidney-shaped, plane or centrally depressed, olivaceous yellow to dull yellow with ochraceous tints, up to 20 cm in diam. nearly glabrous or cracked into very small scales (about 0.3–0.5 mm wide), margin even or undulated.

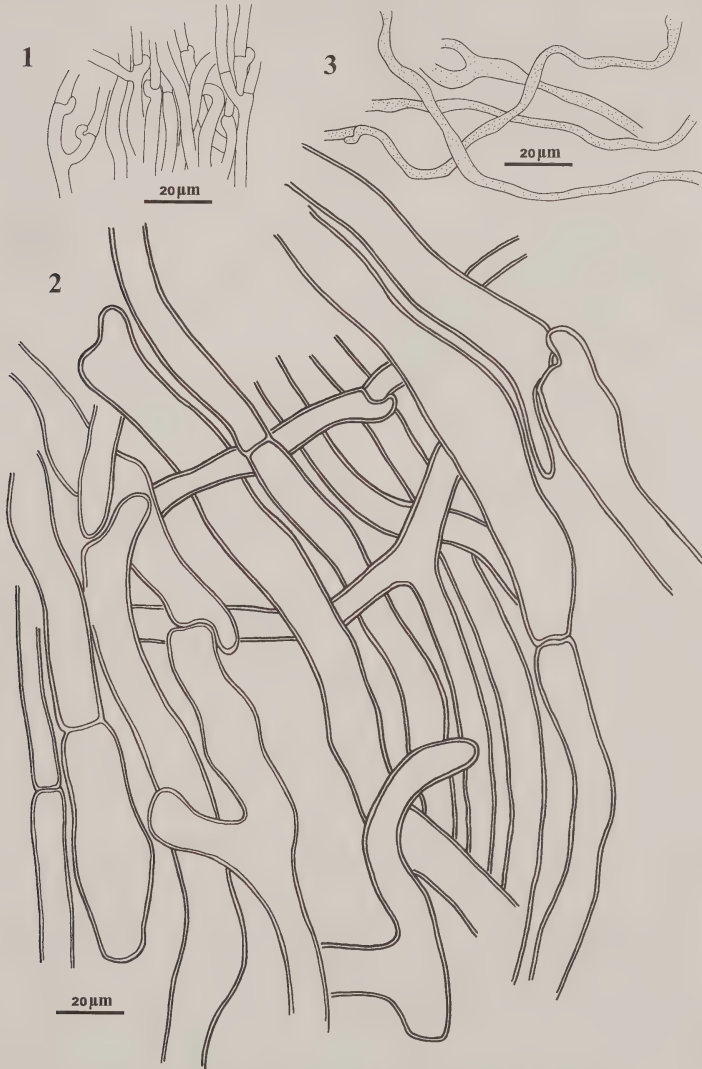
Tube layer 1–5 mm thick, cream when fresh, discoloring flesh-pinkish to red gradually when touched or bruised, becoming pale brownish to reddish brownish after drying, decurrent nearly to the base of the stipe; pores angular, 1–3/mm.

Stipe central, eccentric or lateral, concolorous with the pileus or somewhat darker, bulbous, distinctly inflated at the base, 4–7 $\times$ 2.5–7 cm.

Context white, whitish or cream when fresh, becoming darker after exposed in the air for some time, light yellow to light orange after drying, fleshy, soft, up to

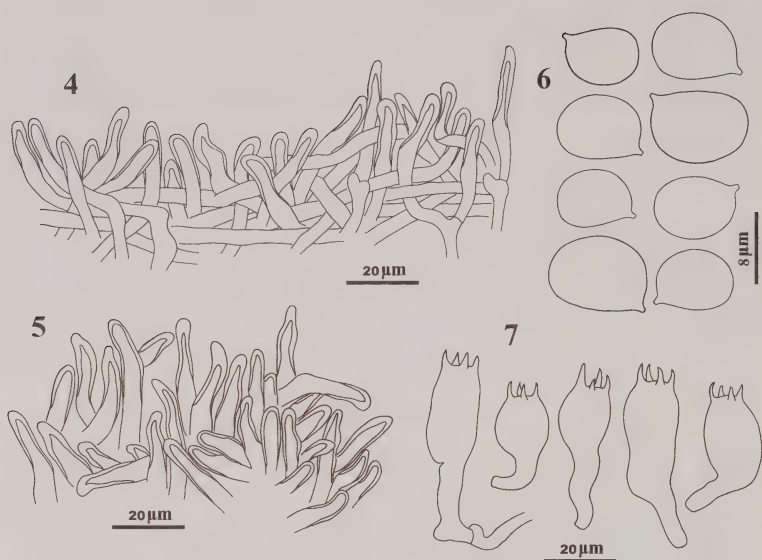
5 cm thick, separated from the tubes by a thin and dark layer in dry specimens, odor pleasant and taste mild.

Hyphal system monomitic, generative hyphae with clamp connections. Tramal hyphae (Fig. 1) 2.0–5.0 μm in diam. thin-walled, with conspicuous clamp



Figs. 1–3: *Albatrellus yunnanensis* (HKAS 37107, holotype)

1. tramal hyphae; 2. contextual hyphae; 3. gloeoplerous hyphae (HKAS 32906)



Figs. 4–7: *Albatrellus yunnanensis* (HKAS 37107, holotype)
4. pileipellis hyphae; 5. stipitipellis hyphae; 6. basidiospores; 7. basidia

connections, occasionally branched. Contextual hyphae (Fig. 2) varying in diam. from 4 µm to 20 µm, thick-walled (0.5–1.0 µm thick), branched. Gloeoplerous hyphae (Fig. 3) present in context and trama, thin-walled, long, with occasional clamp connections. Pileipellis hyphae (Fig. 4) erect, 3.0–5.0 µm in diam. with thick-walled tips, forming a loose palisade. Stipitipellis hyphae similar (Fig. 5). Basidiospores (Fig. 6) ellipsoid to subglobose, hyaline, smooth, non-amyloid, (7.5–) 7.8–9.9 (–11.8) × (5.3–) 6.0–7.5 (–8.0) µm (182 spores), [$Q = (1.13–) 1.21–1.42$ (–1.53), $Q = 1.31 \pm 0.07$].

Basidia (Fig. 7) clavate, with a narrow base and a basal clamp connection, 4-sterigmate, 25–48 × 10–15 µm.

Specimens examined —CHINA, Yunnan Prov.: Nanhua county wild mushroom market, 9. Sept. 2000, leg. Xiang-Hua Wang 1154 (HKAS 37107, **holotype**); 3 Aug. 1998, Xiang-Hua Wang 619 (HKAS 32906); 12 July 2001, Xiang-Hua Wang 1231 (HKAS 39167); 16 Aug. 2004, Huan-Di Zheng 585 (HKAS 48311)

Remarks—The combination of the glabrous to more or less squamulose pileal surface, olivaceous yellow to dull ochraceous yellow coloration and non-amyloid, relatively large basidiospores distinguish this species from other members in the genus.

Because the macroscopic characters of *A. yunnanensis* are similar to those of *A. mexicanus* (Laferrière & Gilbertson 1990), we studied the holotype (BPI-US 1107534) of the latter. Our observations on that specimen are as follow:

Pileus circular or nearly so, glabrous, pale buff, tawny or pale brown, up to 9 cm in diam. Stipe up to 5 cm long and 2 cm wide, cylindrical with a bulbous base, concolorous with the pileus. Tube yellowish green to reddish brown, angular, 1 mm in diam. or even larger. Context pale orangish, 5 mm thick. Basidiospores non-amyloid, subgloboae to broadly ellipsoid, $(7.5-) 7.8-9.3 (-9.8) \times (5.8-) 6.0-7.2 (-8.0) \mu\text{m}$, rough, with a double wall separated by interwall pillars, not glabrous as mentioned in its original description. Hyphal system monomitic, with clamp connections and simple septa.

These features agree with the diagnostic characters of *Polyporoletus sublividus* (Snell 1936, Gilbertson & Ryvarden 1986–1987). Therefore *Albatrellus mexicanus* Laferr. & Gilb. is treated as a synonym of *Polyporoletus sublividus* Snell. Basidiospore morphology helps separate *A. yunnanensis* and *P. sublividus*.

Albatrellus ellisii, *A. pes-caprae* (Pers.) Pouzar, and *A. skamianus* (Murrill) Pouzar have basidiospores of similar size. But they could be distinguished from *A. yunnanensis* by the morphological characters (see the following key). *A. confluens* is similar to *A. yunnanensis* in the size and color of the basidiocarps, but the basidiospores of the former are much smaller and its pileus is usually with orange or pinkish tints and more glabrous.

Key to *Albatrellus* species known from China

- 1 Hyphae with clamp connections 2
- 1 Hyphae without clamp connections 8
- 2 Basidiospores up to 6 μm long 3
- 2 Basidiospores 7–11 μm long or even longer 5
- 3 Pileus and stipe yellow, tissue not becoming red in dry specimens, basidiospores non-amyloid, $3.5-4.5 \times 2.5-3.5 \mu\text{m}$ *A. peckianus*
- 3 Pileus and stipe pinkish buff, pale orange to grayish blue, basidiospores smooth, moderately amyloid, $3.5-5.5 \times 3-4.5 \mu\text{m}$ 4
- 4 Pileus surface pale orange, usually with olivaceous tint, but no blue tint *A. confluens*
- 4 Pileus and stipe grayish blue, some place part yellowish green, but the blue color often disappeared in old specimens or during drying, pore surface and context of apricot color *A. flettii*
- 5 Pileal surface nearly glabrous or cracked into very small scales, olivaceous yellow to dull yellow with ochraceous tints, basidiospores non-amyloid, $(7.5-) 7.8-9.9 (-11.8) \times (5.3-) 6.0-7.5 (-8.0) \mu\text{m}$ *A. yunnanensis*

- 5 Pileal surface apparently cracked or with very coarse scales 6
- 6 Pileal surface grayish-brown, fuliginous to nearly black, cracked into small scales, basidiospores non-amyloid, $7-9 \times 5-6.5 \mu\text{m}$ *A. skamanius*
- 6 Pileal surface yellowish or brownish, with distinct scales 7
- 7 Pileal surface yellowish, dull yellow or with greenish tints, becoming grassy green when touched or bruised, with thick and coarse scales, basidiospores non-amyloid, $7-10 \times 5.5-8 \mu\text{m}$ *A. ellisii*
- 7 Pileal surface grayish brown to reddish brown, never become grassy green when bruised, with fibrillose scales, basidiospores non-amyloid, $7-10 \times 5.5-7 \mu\text{m}$ *A. pes-caprae*
- 8 Pileal surface brown to black, viscid, with a resinous cuticle glossy after drying, pore surface white, pileipellis hyphae ends clavate, basidiospores non-amyloid, $4-5.5 \times 3.5-5 \mu\text{m}$ *A. yasudae*
- 8 Pileal surface without a viscid resinous cuticle 9
- 9 Fruitbodies caespitose with numerous petaloid pilei, vivid yellow or with pale brownish tint, basidiospores non-amyloid, $3.5-5 \times 3-4 \mu\text{m}$ *A. dispansus*
- 9 Fruitbodies with single or a few confluent pilei 10
- 10 Pileal surface and pore surface with blue or grayish tints, basidiospores non-amyloid, $4-5.5 \times 3-4.5 \mu\text{m}$ *A. caeruleoporus*
- 10 Pileus white, pale tan, greenish yellow to brownish 11
- 11 Pileus and stipe greenish yellow, near glabrous or with small scales, pore surface whitish or with yellowish tint, basidiospores non-amyloid to weakly amyloid, $5-7 \times 4-5.5 \mu\text{m}$ *A. cristatus*
- 11 Pileus surface white, pale tan to brownish 12
- 12 Pileus pale brown, with distinct small darker scales, stipe apricot with a black base, basidiospores amyloid, $4-5 \times 3-4 \mu\text{m}$ *A. tianschanicus*
- 12 Fruitbodies whitish, at least when young 13
- 13 Basidiospores non-amyloid, growing under *Picea* forest *A. ovinus*
- 13 Basidiospores amyloid 14
- 14 Basidiospores $4.5-5.5 \times 3.5-4.5 \mu\text{m}$, pileus first white, turning citric yellow when matured, discoloring yellow when bruised, growing under *Picea* forest *A. citrinus*
- 14 Basidiospores $4.0-5.0 \times 3.0-3.5 \mu\text{m}$, pileus white, discoloring orange when bruised, growing under *Pinus* forest *A. subrubescens*

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A new generic approach to the taxonomy of predatory anamorphic *Orbiliaceae* (Ascomycotina)

YING YANG^{1,2} & XING ZHONG LIU¹

liuxz@sun.im.ac.cn

¹Key Laboratory of Systematic Mycology & Lichenology
Institute of Microbiology, Chinese Academy of Sciences
P.O. Box 2714, Beijing 100080, China

²Graduate School of the Chinese Academy of Sciences

Abstract—The types of trapping devices have been extensively accepted as the main morphological criterion for delimitation of the predatory anamorphic genera of orbiliaceous fungi. However, there were a few taxa exceptional. Multigene sequences including rDNA of ITS region and three protein-coding genes were analyzed. Three main clades were formed in the phylogenetic trees. Two clades corresponded to trapping devices of adhesive network (*Arthrobotrys*) and constricting rings (*Drechslerella*), respectively. However, *Dactylellina* forming stalked knobs and non-constricting rings and *Gamsylella* forming sessile adhesive knobs and adhesive columns were clustered into one clade when data were analyzed. Herewith, we propose to combine *Dactylellina* and *Gamsylella* into one genus. The generic concept of *Dactylellina* is emended and three new combinations are proposed.

Key words—predatory fungi, phylogenetic analysis

Introduction

Nematode-trapping hyphomycetes are the representatives of predatory fungi. Traditionally, taxonomy of predatory hyphomycetes was based on the morphology of conidia and conidiophores for delimitation of genera, and has been revised several times (Subramanian 1963, Liu & Zhang 1994, Rubner 1996). However, the evidence from molecular data demonstrated that trapping devices are phylogenetically more informative than the morphological characters of conidia and conidiophores (Persson et al. 1996, Liou & Tzean 1997, Pfister 1997, Ahrén et al. 1998, Hagedorn & Scholler 1999). The phylogenies based on 18S rDNA sequences were neither concordant with the morphology of conidia, nor conidiophores, but rather with the morphology of the trapping devices (Ahrén et al. 1998). Same result was obtained by the analysis of a 1.2 kb long fragment of ribosomal DNA (rDNA) sequence including the 3' of the

18S rDNA and the ITS region. It was therefore suggested to delimit genera of nematode-trapping fungi by using the type of trapping device, while distinguish species with morphological characters of conidiogenous cells and conidia (Liou & Tzean 1997). In line with the above suggestion, a generic conception for predatory anamorphic *Orbiliaceae* has been proposed by Scholler et al. (1999). The predatory fungi were divided into four genera: *Arthrobotrys* Corda forming adhesive networks; *Drechslerella* Subram. forming constricting rings; *Dactylellina* M. Morelet forming stalked adhesive knobs, and *Gamsylella* M. Scholler et al. for species producing adhesive columns and unstalked knobs.

Although the classification of predatory hyphomycetes based on trapping devices has been extensively accepted, *Gamsylella* and *Dactylellina* have the same type of trapping device e.g. adhesive knobs, as well as some taxa such as *Gamsylella phymatopaga* located between those two genera in the phylogenetic tree (Hagedorn & Scholler 1999). More molecular evidence especially protein gene sequence, in addition to rDNA, needs to be analyzed. The purpose of the present study is to get more apprehensive understanding on the taxonomy of predatory orbiliaceous fungi by phylogenetic analyses of three protein-coding gene partial sequences (elongation factor 1- α *efl- α* ; RNA polymerase II subunit, *rpb2*; β tubulin, *bt*) and ITS region in rDNA.

Materials and methods

Biological materials and sequences collection— Twenty-nine fungi were selected in this study, including 28 predatory fungi subjecting to four genera and one strain of *Vermispora fusarina* Burghouts & W. Gams as outgroup. Most strains were isolated from soil samples in China by using soil sprinkling technique (Duddington 1955, Barron 1977) and identified following the system of Scholler et al. (1999). One strain of each *Dactylellina appendiculata* (Anastasiou) M. Scholler et al. (CBS 206.64) and *D. entomopaga* (Drechsler) M. Scholler et al. (CBS 642.80) were from Centraalbureau voor Schimmelcultures (CBS).

The methods for fungal culture, genomic DNA extraction, PCR product purification and sequencing have been described previously (Yang & Liu 2005). The four gene segments selected for phylogenetic analysis were the ribosomal RNA gene in the ITS regions (ITS1-ITS4, White et al., 1990), beta-tubulin gene (*bt*) (Bt2a-Bt2b, Glass & Donaldson 1995), the second subunit of RNA polymerase II gene (*rpb2*) between exon 6 and exon 7 (6F-7R and 5F-7CR, Liu et al. 1999), and elongation factor 1- α gene (*efl- α*) (526F-1567R, O' Donnell et al. 1998).

Sequence alignment—Nucleotide sequences were aligned using Clustal X 1.81 (Thompson et al. 1997) under the default settings (multiple alignment parameters: gap opening 10.00 and gap extension 0.20) to produce an initial alignment. This process was followed by manual adjustments using BioEdit version 5.0.6 (Tom Hall, Department of Microbiology, North Carolina State University, Raleigh, NC 27695). A large intron of 610 bp within *efl- α* region was eliminated due to the difficulty in both sequencing

Table 1. Biological materials used in phylogenetic analysis.

Species name	Traps	<i>bt</i>	<i>efl-α</i>	<i>rpb2</i>	ITS
<i>Arthrobotrys anomala</i>	An	AY773363	AY773393	AY773422	AY773451
<i>Arthrobotrys conoides</i>	An	AY773367	AY773397	AY773426	AY773455
<i>Arthrobotrys eudermata</i>	An	AY773378	AY773407	AY773436	AY773465
<i>Arthrobotrys iridis</i>	An	AY773364	AY773394	AY773423	AY773452
<i>Arthrobotrys janus</i>	An	AY773371	AY773401	AY773430	AY773459
<i>Arthrobotrys musiformis</i>	An	AY773382	AY773411	AY773440	AY773469
<i>Arthrobotrys oligospora</i>	An	AY773374	AY773404	AY773433	AY773462
<i>Arthrobotrys pseudoclavata</i>	An	AY773359	AY773388	AY773417	AY773446
<i>Arthrobotrys pyriformis</i>	An	AY773362	AY773392	AY773421	AY773450
<i>Arthrobotrys sinensis</i>	An	AY773358	AY773387	AY773416	AY773445
<i>Arthrobotrys thaumasia</i>	An	AY773373	AY773403	AY773432	AY773461
<i>Arthrobotrys vermicola</i>	An	AY773366	AY773396	AY773425	AY773454
<i>Dactylellina appendiculata</i>	Sk	AY965822	DQ358227	DQ358229	AF106531
<i>Dactylellina drechsleri</i>	Sk	AY773377	AY773390	AY773419	AY773448
<i>Dactylellina ellipsospora</i> S1	Sk	AY773361	AY773391	AY773420	AY773449
<i>Dactylellina ellipsospora</i> S2	Sk	AY773370	AY773400	AY773429	AY773459
<i>Dactylellina entomopaga</i>	Sk	AY965831	DQ358228	DQ358230	AY965758
<i>Dactylellina parvicollis</i>	Sk	AY773385	AY773414	AY773443	AY773472
<i>Dactylellina haptotyla</i>	Sk & Ncr	AY773383	AY773412	AY773441	AY773470
<i>Dactylellina leptospora</i>	Sk & Ncr	AY773379	AY773408	AY773437	AY773466
<i>Dactylellina cionopaga</i> C1	Ac	AY773380	AY773409	AY773438	AY773467
<i>Dactylellina cionopaga</i> C2	Ac	AY773381	AY773410	AY773439	AY773468
<i>Dactylellina cionopaga</i> C3	Ac	AY773384	AY773413	AY773442	AY773471
<i>Dactylellina cionopaga</i> C4	Ac	AY773386	AY773415	AY773444	AY773473
<i>Drechlerella brochopaga</i>	Cr	AY773368	AY773398	AY773427	AY773456
<i>Drechlerella coelobrocha</i>	Cr	AY773376	AY773406	AY773435	AY773464
<i>Drechlerella dactyloides</i>	Cr	AY773375	AY773405	AY773434	AY773463
<i>Drechlerella stenobrocha</i>	Cr	AY773372	AY773402	AY773431	AY773460
<i>Vermispora fusarina</i>	Outgroup	AY773360	AY773389	AY773418	AY773447

An = adhesive networks; Sk = stalked knobs; Ncr = non-constricting rings;

Ac = adhesive columns; Cr = constricting rings.

and alignment. Each individual gene region analyses represented similar topological structure, so the four segments were combined into one alignment of 2562 nucleotide sites (including gaps), which consisted of 532 bp from the 5' end of *bt* gene, 703 bp in the exon 6 of *rpb2* gene, 771 bp from the 5' end of *ef1- α* gene, and 556 bp of rDNA in the ITS regions. There were six non-coding regions in this alignment, including three in the *bt* gene, one in the *ef1- α* gene and two in the ITS regions.

Phylogenetic analysis—Preliminary analysis of the obtained data showed that none of individual fragment of the three protein gene sequences was informative enough to give a more reasonable phylogenetic structure. Thus, two sets of data, one with ITS sequences only and the other one with a combined sequences of the four genes, were separately sent to PAUP* 4.0b 10 (Swofford 2000) for the final phylogenetic analysis. Maximum parsimony (MP) analyses were performed with heuristic searches consisting of 1000 random sequence addition replicates with tree bisection-reconnection (TBR) branch swapping. All characters were equally weighted and unordered.

Results

Lineages in predatory fungi—Four fine-scale lineages were identified within predatory hyphomycetes with moderate to strong bootstrap support in ITS region (BP 75–100%), while three lineages with more detail information were obtained by using the combined sequences of ITS, *rpb2*, *ef1- α* and *bt*. The constricting ring group (the genus of *Drechslerella*) was first separated from the predatory hyphomycetes as a paraphyletic clade of the adhesive groups. The adhesive network group evolved into a monophyletic clade with more credible bootstrap supports (BP 90% & 100%). However, the lineage of adhesive column which was labeled with grey resulted in a variable relationship with other adhesive groups in different trees (Fig. 1). Although the knob group has various morphological forms of trapping device, and presents a more relaxed topology with a lower bootstrap support, it is a real monophyletic clade.

Phylogeny based on ITS sequences—The ITS rDNA parsimony analysis resulted in a single most parsimonious tree (Fig. 1A), with a tree length of 895 [consistency index (CI) = 0.5631; retention index (RI) = 0.6370; rescaled consistency index (RC) = 0.3587]. The 50% majority rule consensus phylogram revealed that two lineages of non-adhesive group and adhesive group were well divided with strong bootstrap support (BP 87% & 79%), and three subclades corresponding to three types of trapping devices (adhesive knobs, adhesive networks, and adhesive columns) were clearly indicated in the adhesive group.

Phylogeny based on the combined data of ITS, *bt*, *rpb2* and *ef1- α* —The MP analysis of the combined data produced one tree with a tree length of 4918 steps (CI = 0.4392; RI = 0.5473; RC = 0.2404). The 50% majority rule consensus phylogram (Fig. 1B) also revealed that predatory hyphomycetes were composed of two lineages, non-adhesive group and adhesive group. For the adhesive

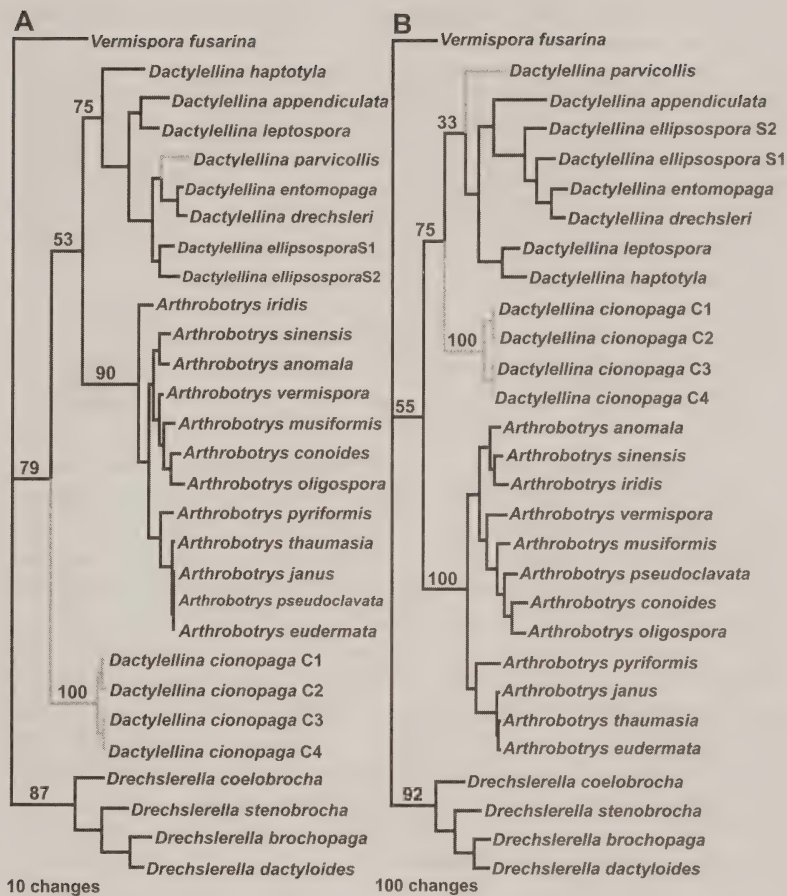


Fig. 1. Phylogram of bootstrap 50% majority-rule consensus tree. The numbers above the branches indicate the bootstrap values obtained for 1000 replicates and only bootstrap values of each groups are shown. A. MP tree of ITS sequences analysis. B. MP tree of combined data analysis.

clade, the adhesive column subclade (*Gamsylella*) and adhesive knob subclade (*Dactylellina*) were clustered into one monophyletic group with 75% bootstrap support and seemed evolving paraphyletically with adhesive network group. It suggested that *Dactylellina* and *Gamsylella* should be combined into one genus. Furthermore, the trapping devices such as stalked adhesive knobs, sessile knobs, and adhesive columns were morphologically similar. We concluded that

Gamsylella was synonym of *Dactylellina* and the generic circumscription of *Dactylellina* was amended.

Taxonomy and nomenclature—*Arthrobotrys*, *Drechslerella* and *Dactylellina* are recognized predatory oriboliceous hyphomycetes. *Arthrobotrys* is composed of the fungi forming adhesive networks, *Drechslerella* consists of fungi forming constricting rings and *Dactylellina* includes fungi forming adhesive knobs, columns, and non-constricting rings. The species formerly assigned into *Gamsylella* should be transferred into *Dactylellina* and three new combinations were proposed.

Dactylellina M. Morelet emend. Ying Yang & Xing Z. Liu

Type species: *Dactylellina leptospora* (Drechsler) M. Morelet, Bull. Soc. Sci. Nat. Archéol. Toulon Var 178: 6 (1968).

Basionym: *Dactylella leptospora* Drechsler, Mycologia 29: 507 (1937).

Mycelium slow-growing. Hyphae septate, branching, hyaline. Saprotrophic or capturing nematodes or other animals by means of stalked adhesive knobs, sometimes in combination with non-constricting rings, or by means of unstalked non-detachable adhesive knobs or two- to multi-celled columns. Columns constricted at the septa and sometimes forming loops or fusing with a neighboring column. Traps usually formed spontaneously. Conidiophores mostly simple, if branched then often near the apex. Conidiogenous cells monoblastic or multiblastic with short denticles. Conidia holoblastic, formed singly or in clusters on the tip of the conidiogenous cells, hyaline, 1–7(–15)-septate, mostly cylindrical, ellipsoidal, fusiform or spindle-shaped, rarely clavate or obconical. Microconidia and microconidiophores rarely formed. Chlamydospores absent. Teleomorph: *Orbilia* (Liu et al. 2005).

Species transferred into *Dactylellina*

1. *Dactylellina arcuata* (Scheuer & J. Webster) Ying Yang & Xing Z. Liu **comb. nov.**

Mycobank Number: MB 510274.

Basionym: *Dactylella arcuata* Scheuer & J. Webster, Mycol. Res. 94: 720 (1990).

2. *Dactylellina gephyropaga* (Drechsler) Ying Yang & Xing Z. Liu **comb. nov.**

Mycobank Number: MB 510272.

Basionym: *Dactylella gephyropaga* Drechsler, Mycologia 29: 512 (1937).

3. *Dactylellina cionopaga* (Drechsler) Ying Yang & Xing Z. Liu **comb. nov.**

Mycobank Number: MB 510273.

Basionym: *Dactylella cionopaga* Drechsler, Mycologia 42: 30 (1950).

Discussion

The knob-forming species of the nematode-trapping fungi have diverse configurations such as sessile knobs, stalked knobs, a combination of stalked knobs with non-constricting rings, or stalked knobs with proliferated knobs. All of these trapping structures are morphologically similar and their evolutionary radiation has been proposed recently (unpublished). *Dactylellina parvicollis* captures nematodes by means of (short stalked) knobs, which can grow out to form loops (Drechsler 1962). Drechsler (1954) first described that *D. phymatopaga* captured nematodes by sessile knobs, but Rubner (1996), after reexamined many isolates of this species, found that their knobs were not always sessile and tended to develop stalks up to 12 μm long. It means that both *D. phymatopaga* and *D. parvicollis* could produce stalked knobs. Although Scholler et al. (1999) assigned those two species into *Gamsylella*, they have basic characters (stalked knobs) of *Dactylellina*. Liou & Tzean (1997) used *D. phymatopaga* as outgroup in ITS phylogenetic analysis and did not give any concrete description. While in the phylogenetic analysis conducted by Hagedorn & Scholler (1999), *D. phymatopaga* was positioned between the column group and the knob group. Species with unstalked adhesive knobs were considered primitive by Rubner (1996). This group should be at the basal position of the evolution of knob trapping devices (Liou & Tzean 1997, Hagedorn & Scholler 1999). There were six species assigned in *Gamsylella* (Scholler et al. 1999). *D. phymatopaga*, *D. parvicollis*, *D. lobata* and *D. robusta* have been moved to *Dactylellina*, and the other two species in *Gamsylella* forming adhesive columns and sessile knobs were placed in *Arthrobotrys* (Li et al. 2006). The trapping devices produced by these two species are similar to adhesive knobs produced by *Dactylellina*. By our combined data analysis, *D. cionopaga* was closer to *Dactylellina* than *Arthrobotrys*. Both morphological characters and molecular evidences proved that these species should be included in *Dactylellina*.

The *rpb2* exons exhibit a higher percentage of potentially parsimony-informative characters than exons of *bt* and *efl- α* , both of which exhibit similar amounts. Each of four fragments with their introns has many parsimony-informative characters, but it was not enough for phylogenetic analysis under genus because of the limitation of sequence information. Single gene analysis may not give a resolved strict consensus tree, and not represent the evolution of all genes in organisms. Three genes, which involved in transcription, translation, and cytoskeleton respectively, were combined into one dataset to overcome the limitation of rDNA of the ITS region. Not only the rDNA gene but also protein-coding genes were sent to phylogenetic analysis, the high degree of congruence with complex morphological characters like trapping devices makes us confident that the true species tree will only differ in minor details.

This combined sequence analysis displayed a convincingly approach to the real phylogeny.

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Appendicispora*: a new genus in the arbuscular mycorrhiza-forming Glomeromycetes, with a discussion of the genus *Archaeospora

JOYCE L. SPAIN^{1*}, EWALD SIEVERDING² & FRITZ OEHL³

¹*lancespain@comcast.net

3500 NW Hayes, Corvallis, Oregon 97330, USA

² Institute for Plant Production and Agroecology in the Tropics and Subtropics
University of Hohenheim, Garbenstrasse 13, D-70599 Stuttgart, Germany

³ Zurich-Basel Plant Science Center, Institute of Botany, University of Basel
Hebelstrasse 1, CH-4056 Basel, Switzerland

Abstract—A new genus of arbuscular mycorrhizal fungi, *Appendicispora* (*Archaeosporaceae*), is described. New species names are: (i) *Ap. appendicula*, the type species derived from the dimorphic *Acaulospora appendicula*, a “synonym” of *Ac. gerdemannii* erroneously thought to represent the acaulosporoid form of *Archaeospora leptoticha*; (ii) *Ap. gerdemannii*, based on *Archaeospora* (*Glomus*) *gerdemannii*; and (iii) *Ap. jimgerdemannii*, a nom. nov. for the former *Ac. gerdemannii*. *Archaeospora trappei*, which remains alone in the now monotypic *Archaeospora*, differs from the *Appendicispora* species in spore development, wall morphology, germination, and root colonization structures; its separation is further supported by molecular data. In *Appendicispora*, acaulosporoid spores are all three-walled and have an appendix arising laterally from the hyphal neck of a terminal sporiferous sacculus. Distributional data are provided that expand the range of *Appendicispora* species from the Mediterranean and (sub)tropical climates to arbuscular mycorrhizal fungi communities in cold subalpine and alpine areas.

Key words—Glomeromycota, dimorphism

Introduction

In this study, we discuss the genus *Archaeospora* J.B. Morton & D. Redecker (Morton & Redecker 2001) of the *Archaeosporaceae* and erect a new genus in this family of the Glomeromycetes. The history of *Archaeospora* and its three members is rather complicated. The difficulties derive from the dimorphic nature of *Acaulospora appendicula* (Schenck et al. 1984), the first diagnosis of an *Acaulospora* species having two morphs, and from the synonymization by Morton & Redecker (2001) of two distinctly different acaulosporoid spores and a glomoid spore with two *Glomus* species to get to the genus *Archaeospora*,

and from the nomenclature which had to be applied to distinguish between an *Archaeospora* sp. derived from *Glomus gerdemannii* (Rose et al. 1979) and an *Archaeospora* sp. which derived from *Ac. gerdemannii* (Nicolson & Schenck 1979).

Materials and methods

Investigation of type material

We investigated type material of the following epithets: type and isotype material of *Ac. gerdemannii* (#OSC 37,514 and isotype from FH); type material of *Ac. appendicula* (#OSC 41,495) and material from collections maintained by J. L. Spain and E. Sieverding, respectively; type material of *G. gerdemannii* (#OSC 39,476), *G. leptotichum* (#OSC 40,249) and *G. fecundisporum* (#OSC 40,250). Additionally, spores of *Ac. gerdemannii* were isolated from soil samples taken in June 2002 from the Agricultural Research Center at Ona, Florida, a site named by Nicolson & Schenck (1979) where the type specimen was found. Unfortunately, only a few spores of *Ac. gerdemannii* were recovered. Finally, we examined many other specimens of *Ac. appendicula*, *Ac. gerdemannii* and *G. gerdemannii*. These species have been found by the authors of this study during the last 25 years from soils collected from different places in North America, South America, Africa, Asia and more recently (between 2000-2005) from Europe (mainly Switzerland, Germany and France).

Spore wall terminology and analyses

The terminology of the spore wall structure was basically adapted from INVAM (International Culture Collection of Arbuscular and Vesicular-Arbuscular Endomycorrhizal Fungi, see homepage: www.invam.caf.wvu.edu). We recognize three different walls in the new genus, and thus, we adopt the terminology developed for *Acaulospora* spores with three walls (Stürmer & Morton, 1999; Oehl et al. 2006) with some modifications. In detail, we call the three spore walls 'outer spore wall' (ow), 'middle wall' (mw) and 'inner wall' (iw). Most of the analyses of the wall structures were performed on compound microscopes at 400x magnification. Photographs in Figs. 1-9 were taken with a digital camera (Olympus model DP70-CU) on a Zeiss Axioplan compound microscope. Photographs in Figs. 10-12 were taken with a SPOT2 camera mounted on a Leica DMRB microscope at the OSC Mycological Herbarium in Corvallis, Oregon, USA. The legends on the photographs were inserted with Adobe Photoshop 6.0.

Mycorrhizal structures

The descriptions of the mycorrhizal root colonization structures are based on observations of roots derived from pure cultures of the former *Acaulospora*

appendicula on *Sorghum bicolor* (L.) Moench, *Pueraria phaseoloides* (Roxb.) Benth., *Manihot esculenta* Crantz or *Allium porrum* L. Cultures were maintained for many years by J. Classen de Miranda and J. L. Spain at the Centro de Pesquisa Agropecuária dos Cerrados, CPAC, Brasília, Brazil, by J. L. Spain in Corvallis, Oregon, and by E. Sieverding and S. Toro at the Centro Internacional de Agricultura Tropical, CIAT, Cali, Colombia. Trypan blue was used to stain the intraradical mycorrhizal root structures using methods explained by Brundrett et al. (1994). Root colonization structures in Fig. 6 are from plants inoculated with spores from the pot type culture of *Ac. appendicula* grown at CIAT.

Discussion of *Archaeospora*

The following species descriptions must be taken into consideration to understand the history of the genus *Archaeospora* in the *Archaeosporaceae* of the Glomeromycetes:

Schenck et al. (1984) described *Acaulospora appendicula* as a dimorphic arbuscular mycorrhizal species, forming acaulosporoid spores on a short cylindric hyphal appendix (for which Schenck et al. 1984 used the term 'hyphal pedunculate protuberance' and Morton & Redecker 2001 the term 'pedicel') arising laterally from the hyphal neck of the sporiferous saccule, and also glomoid spores and vesicle-like structures on the extraradical mycelium. Morton et al. (1997), believing that *Acaulospora gerdemannii* developed the same morphological characteristics as *Ac. appendicula*, synonymized the two. In the same paper, Morton et al. (1997) also described the glomoid spore of *Ac. appendicula* as identical to *G. leptotichum* N.C. Schenck & G.S. Sm., which they synonymized with *G. fecundisporum* N.C. Schenck & G.S. Sm.

More recently, Morton & Redecker (2001) combined *Ac. gerdemannii* and *G. leptotichum* as *Archaeospora leptoticha* and transferred *Glomus gerdemannii* to *Archaeospora*. Spain (2003), however, recently noted that the type species of *Archaeospora*, *Ar. trappei*, has much smaller spores than *Ar. leptoticha* and *Ar. gerdemannii*, as well as a distinct wall configuration and novel germination structures; it rarely produces glomoid spores.

Salient morphologic features in the diagnoses of *Ac. gerdemannii*, *Ac. appendicula*, *G. leptotichum* and *G. fecundisporum* escaped the attention of Morton and co-workers when they combined the species and subsequently erected the dimorphic genus *Archaeospora*. Acaulosporoid spores of *Ac. gerdemannii* with cerebriform ornamentation on the outer spore wall were combined with *Ac. appendicula*, a taxon with a crazed (fissured, cracked) surface of the outer wall. Type material of *Ac. appendicula* clearly corresponds to the diagnosis. The confusion might have been due to the poor quality of type and isotype material

of *Ac. gerdemannii* in the herbaria. Two of the five original slides of the *Ac. gerdemannii* type material (OSC #41,495) are missing and most of the spores are in very bad condition. However, in 1989, Mohammad Achouri mounted holotype spores of *Ac. gerdemannii*, preserved by Schenck & Nicolson in FAA (formol/acetic acid/alcohol), that clearly show cerebriiform ornamentation on the outer spore wall and confirm other morphological details. Isotype material of *Ac. gerdemannii* (F51804 deposited in FLAS) has been missing for several years, and paratype material deposited at the Farlow Herbarium has degraded, and salient features cannot be discerned on this material. Two early taxonomic keys developed for *Acaulospora* species (Walker & Trappe 1981, Schenck et al. 1984) refer to cerebriiform ornamentation as the salient diagnostic feature of *Ac. gerdemannii*.

Acaulospora appendicula spores have an outer wall with a crazed appearance and — similar to *Ac. gerdemannii* — a middle wall with alveolate ornamentation. Morton et al. (1997), who acknowledge the crazed wall of *Ac. appendicula*, suggest that the wall appears to develop cerebriiform folds on aged spores. We have observed isolates of *Ac. appendicula* from several locations in the world (see distribution below) and have examined spores stored for at least six years at ambient temperature in dry soil at the Centro Internacional de Agricultura Tropical (CIAT) as well as in soil stored at 8° C in a cold room, yet we cannot confirm that the crazed outer spore wall of *Ac. appendicula* develops a cerebriiform ornamentation. Both the herbarium slides of *Ac. gerdemannii* mounted by Achouri and our own examination of spores from the type location clearly confirm Schenck & Nicolson's diagnosis: cerebriiform ornamentation up to 10–12 µm high does form on the spores in this species. The dark field photograph accompanying the diagnosis also shows cerebriiform ornamentation on an apparently young spore attached by an appendix to the sporiferous saccule hypha.

Correspondence of spore morphology in type specimens and vouchers from living cultures was the basis for determining synonymy of *G. leptotichum*, *G. fecundisporum* and the glomoid spore of *Ac. appendicula* (Morton et al. 1997). Schenck & Smith (1982) distinguished *G. leptotichum* with a faint reticulum of ridges most apparent on young spores produced terminally and in an intercalary manner from *G. fecundisporum*, which lacks a reticulum and has generally smaller spores with a yellow to brown wall. Unfortunately, the type material of *G. fecundisporum* shows two very different *Glomus* spore types; both, however, differ from typical *G. leptotichum* spores. Intercalary spore formation has not been reported for the glomoid morph of *Ac. appendicula*, which also does not have a reticulum at any stage. We conclude that *Ac. appendicula* is not synonymous with *G. leptotichum*.

There are also two very different *Glomus* spores on the *G. leptotichum* type slide (OSC #40,249) labeled 'Roots'. Two of several small spores are germinating. There are also three acaulosporoid spores on one of the *G. leptotichum* (OSC #40,249) slides; two are parasitized and lack a spore wall, although they do possess a single alveolate reticular wall and an inner laminated wall. Morton et al. (1997) refer to a single acaulosporoid spore, which they interpreted as an acaulosporoid spore of *Ac. gerdemannii*; this spore lacks the crazed outer wall typical of *Ac. appendicula* but possibly has remnants of cerebriiform ornamentation.

Redecker et al. (2000) performed molecular analyses on spores that they attributed to *Ac. gerdemannii* sensu Morton et al. and its glomoid synanamorph, which they called *G. leptotichum*. They analyzed spores produced in pure cultures under controlled conditions, concluding from the biochemical and genetic data that both morphs belonged to one species. However, we feel that the authors used *Ac. appendicula* and the known glomoid morph of this species in their studies instead of *Ac. gerdemannii*, because *Ac. gerdemannii* is not known from pot cultures and its glomoid morph remains unknown. On the other hand, *Ac. appendicula* and its glomoid morph have been propagated many times in pure cultures at CIAT in Colombia. If a glomoid spore of *Ac. appendicula* was erroneously assumed to represent *G. leptotichum*, it is not surprising that the two morphs of *Ac. appendicula* gave the same genetic information.

Morton & Redecker (2001) combined *Ac. trappei*, *Ac. gerdemannii* (the description referring to *Ac. appendicula*), and *G. gerdemannii* in their new genus, *Archaeospora*, based on shared molecular genetic information generated by Redecker et al. (2000). The phylogenetic tree of Redecker et al. (2000) supports *Ac. gerdemannii*, *G. leptotichum* and *G. gerdemannii* as closely related species that clearly differ from *Ac. trappei*. Their data thus also support separation of the four species at the molecular level into two genera. The type species of the genus *Archaeospora*, *Ar. trappei*, differs from the other species of the genus not only in spore size but also in spore development and germination, wall morphology, and root colonization structures. These observations led us to erect a new genus in the *Archaeosporaceae*.

Schenck et al. (1984) included both acaulosporoid and glomoid spores in the diagnosis of *Ac. appendicula*; thus this species is suitable to serve as type for the new genus *Appendicispora*, particularly when the spore morphology and germination are so well known.

Because we propose to transfer two different species with the same specific epithet to our new genus, we must rename the later-named taxon in accordance with Art. 11.3 of the International Code of Botanical Nomenclature (Greuter et al. 2000). *Archaeospora gerdemannii*, first published (as *Glomus gerdemannii*)

on January 13, 1979, has priority over *Ac. gerdemannii* and so is transferred to *Appendicispora* as *Ap. gerdemannii*. We propose the new name, *Ap. jimgerdemannii*, for the later described *Acaulospora gerdemannii*.

Because we consider that the glomoid morph of *Ac. appendicula* is not synonymous with either *G. leptotichum* or *G. fecundisporum*, we exclude the latter two fungal species from the *Archaeosporaceae* and return them to the genus *Glomus*.

Description of new genus

Appendicispora Spain, Oehl & Sieverd. gen. nov.

MB510319

Sporae dimorphae vel monomorphae: Sporae acaulosporoideae ternibus tunicis ex appendice formatae, lateraliter ex hypha terminata in sacculo sporifero; germinatio ex tunica interior Ubi presentes sporae glomoideae singulares vel plerique. Arbusculae, vesiculae, hyphaeque mycorrhizarum tinguntur pallidae.

Etymology: from the Latin appendix = appendage, and *spora* = spore.

KEY CHARACTERS—Sporocarp formation unknown; species generally dimorphic with mycorrhizal associations producing both acaulosporoid and glomoid morphs (glomoid morph not known for all species). *Acaulosporoid* spores on short hyphal appendix arising laterally from the hyphal neck of a terminal sporiferous saccule; with outer, middle and inner wall; germinating from the innermost wall with germ tube emerging through the appendix attachment; a germination structure possibly forming between inner and middle wall. *Glomoid* spores formed singly in soil or in loose clusters on the root with external hyphae germinating through the subtending hypha. *Root arbuscles* and *vesicles* stain pale blue with trypan blue.

TYPE SPECIES—*Appendicispora appendicula* (Spain, Sieverd. & N.C. Schenck) Spain, Oehl & Sieverd. comb. nov.

Discussion—The principal characters that differentiate species of *Appendicispora* from species of other Glomeromycetes genera with acaulosporoid spore formation are in the morphology of the acaulosporoid spores as summarized in Table 1. Basically, acaulosporoid spores of *Appendicispora* differ from *Archaeospora* in having three (instead of only two) spore walls. Additionally, the spores germinate from the inner wall through a germ tube that arises from a specific germination structure to penetrate the middle wall at the pore closure, then the appendix pore followed by the outer wall collar. The germination structure of *Archaeospora trappei* emerges through the outer wall. Additionally, *Appendicispora* may form vesicles in the roots. Although Ames & Linderman (1976) also reported vesicles for *Archaeospora trappei*, Morton & Redecker (2001) did not confirm their formation.

Table 1. Principal morphological characteristics separating *Appendicispora* gen. nov. from *Archaeospora* and *Acaulospora*

	<i>Appendicispora</i>	<i>Archaeospora</i>	<i>Acaulospora</i>
Spore dimorphy	Yes, acaulosporoid & glomoid	Yes, acaulosporoid & glomoid	Unknown
Number of walls in acaulosporoid (<i>ac</i>) spores	3 (<i>ow</i> , <i>mw</i> , <i>iw</i>)	2 (<i>ow</i> , <i>iw</i>)	3 (<i>ow</i> , <i>mw</i> , <i>iw</i>)
Number of <i>ac</i> spore walls arising from hyphal walls	2 (<i>ow</i> , <i>mw</i>)	1 (<i>ow</i>)	1 (<i>ow</i>)
Number of <i>ac</i> walls formed as new after spore pore closed	1 (<i>iw</i>)	1 (<i>iw</i>)	2 (<i>mw</i> , <i>iw</i>)
Known types of ornamentation on <i>ow</i>	cerebriform	none	cerebriform, pits, reticula, projections
Known types of ornamentation on <i>mw</i>	alveolate	-	none
Known types of ornamentation on <i>iw</i>	none	none	Characteristic 'beaded' iw11
Spore pore closure by	Septum arising from <i>mw</i> 1 and by <i>mw</i> 2	Septum arising from <i>ow</i> 2	Laminae arising from <i>ow</i> 2 and by <i>ow</i> 3
Presence of appendix	Yes	No	No
Germination	From <i>iw</i> forming a specific germination structure, through appendix	From <i>iw</i> with truncated germ tube through <i>ow</i> at any area of surface	From <i>iw</i> with specific germination orb, through <i>mw</i> and <i>ow</i> at any area of surface
Presence of vesicle	Yes	Not described	Yes
Staining of mycorrhizal structures with trypan blue	Faintly to pale blue	Not to faintly	Blue to dark blue

Abbreviation of spore walls and spore wall layers: outer wall (*ow*), middle wall (*mw*) and inner wall (*iw*) with 1-3 layers (e.g. *ow*2, *mw*2).

In *Appendicispora*, acaulosporoid spores form on an appendix, which distinguishes them from *Acaulospora* spores, which sit directly on the hyphal neck of a sporiferous saccule. The *Acaulospora* pore closes by laminae in the outer wall, while the *Appendicispora* pore closes in the middle wall. The *Acaulospora* inner wall contains a 'beaded' wall layer, a character absent in both *Appendicispora* and *Archaeospora*. Finally, the *Acaulospora* intraradical mycorrhizal structures stain blue to dark blue in trypan blue, in contrast to *Appendicispora* (where they stain only faintly to pale blue) and *Archaeospora* (where they stain either faintly or not at all).

Species included in the new genus

Appendicispora appendicula (Spain, Sieverd. & N.C. Schenck) Spain, Oehl & Sieverd.
comb. nov.

FIGURES 1-6

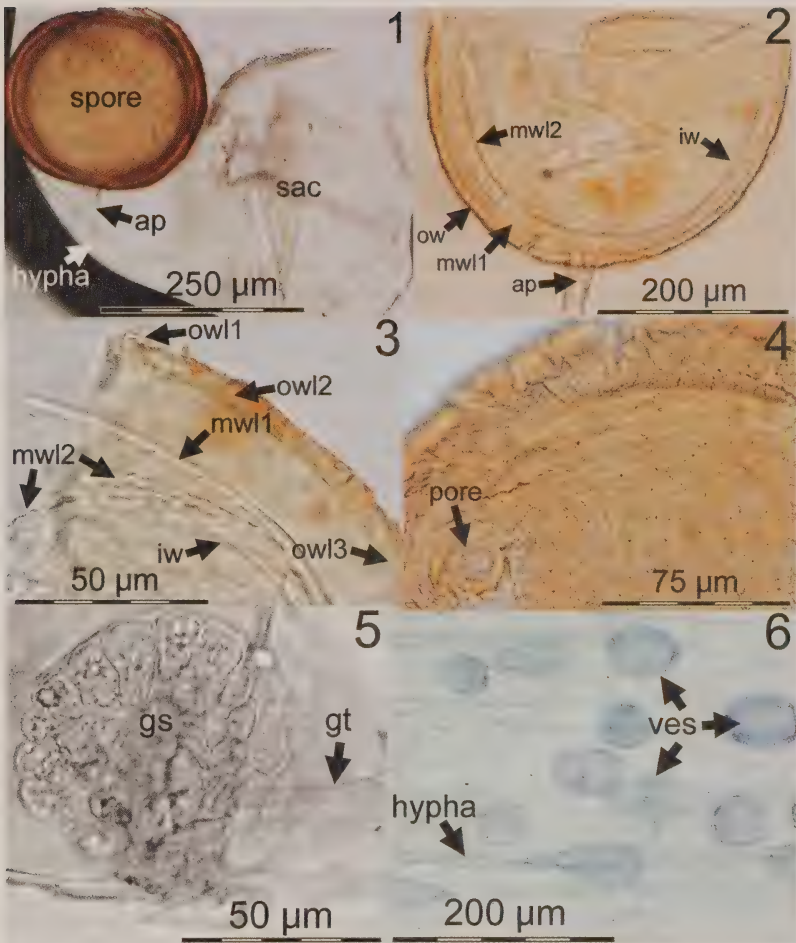
MB510320

Basionym: *Acaulospora appendicula* Spain, Sieverd. & N.C. Schenck, *Mycologia* 76, 686.
August 7, 1984.

Spore formation—Sporocarps unknown. *Acaulosporoid* spores formed singly in the soil upon a short appendix that arises laterally on the tapering hyphal neck of a sporiferous saccule (Fig. 1) and *glomoid* spores formed terminally on hyphae, occurring singly or in loose clusters in the soil. *Acaulosporoid* sporiferous saccules formed on mycelial hyphae with 1-6 μm thick walls; the thick-walled hyphae often rigid, persistent, 12-20(-25) μm wide, sparsely branched, and giving rise to thinner walled hyphae (6-12 μm diam) bearing thick-walled glomoid spores. Often thin walled swollen hyphal tips form on thinner walled hyphae which readily collapse when mounted in lactophenol or PVLG. Both acaulosporoid and glomoid spores may be found on the same mycelium and both can function as colonization propagules.

Sporiferous saccule—Globose to subglobose to rarely ellipsoid, (190-)250(-380) μm diam, formed terminally on a hypha (Fig. 1). Saccule wall consists of one wall with 2-3 wall layers: one very thin, hyaline outer layer (usually difficult to detect), a second layer of overlapping plate-like structures, and a third membranous inner wall layer. Contents are initially white-opaque, later becoming gray-white to subhyaline until saccule becomes transparent as contents discharge to form a spore. Prior to appendix and spore formation, a septum forms in the tapering hypha distal to the saccule where the hyphal appendix is formed. The sporiferous saccule may persist on young specimens and generally does not collapse when detached from the spore at the junction interface.

Acaulosporoid spores—Borne singly on a short hyphal appendix (Fig. 1). Spores are globose to subglobose, (170-)250(-390) μm diam, white-opaque when young, maturing to dull yellow-cream to orange-tan. Three spore walls are present: outer (*ow*), middle (*mw*), and inner (*iw*). The outer wall, which is continuous with the wall of the outer appendix layers and the sporiferous saccule hyphal neck, comprises three layers in young, fully developed spores (Figs. 2, 3). The outer layer (*ow-l* 1) is hyaline and 0.5-1.0 μm thick and often is lost or degrades during the early stages of spore formation. The second layer (*ow-l* 2), initially white, becoming yellow to brown, firm and difficult to break on young spores, turns orange-red in Melzer's reagent, but with age becoming less rigid and staining less red with Melzer's reagent. The *ow-l* 2 is 8-16(-20) μm



Figs. 1-6: *Appendicispora appendicula*. Fig. 1. Spore formed on an appendix (ap) laterally arising from the hyphal neck of a sporiferous saccule (sac). Fig. 2. Crushed acaulosporoid spore with appendix (ap) and three walls: outer wall (ow), middle wall (mw) and inner wall (iw). Outer wall and outer layer of middle wall (mw1) continuous with appendix wall. Fig. 3. Broken acaulosporoid spore with three-layered outer wall (owl1, owl2, owl3), two-layered separated alveolate middle wall (mw1, mw2), and inner wall (iw). Fig. 4. Broken acaulosporoid spore showing the crazed pattern of fine cracks of owl2, and pore after appendix detachment. Fig. 5. Germination structure (gs) on inner wall of acaulosporoid spore with germ tube (gt). Fig. 6. Hyphae and vesicles (ves) in root stained pale blue with trypan blue.

thick, somewhat roughened, with an irregular crazed pattern of fine cracks (Fig. 4). The inner layer (*ow-l* 3) usually is hard to observe as it is very thin (about 0.5-1.0 μm) and often tightly adherent to *ow-l* 2. When the appendix is broken off an open pore is formed in the outer wall that is 20-50 μm wide (Fig. 4).

The middle wall comprises two layers: the outer layer (*mw-l* 1), which is continuous with the thick, hyaline layer of the appendix and second layer of the connected hypha + sporiferous saccule, is hyaline, 2-6 μm thick, and with a convex, alveolate reticulum (Fig. 2, 3). The undulations are 7-12 μm wide and $\leq$ 3-5 μm deep. The *mw-l* 2 is hyaline, 4-8 μm thick, tightly adherent to *mw-l* 1 and thus showing a similar alveolate structure with concave hemispherical depressions on the outer surface that fit into the convex protuberances at the inner surface of *mw-l* 1. Layer *mw-l* 2 may close the pore of the appendix. The layers *mw-l* 1 & 2 separate when pressure ruptures the spore (Figs. 2, 3). *Mw-l* 2 stains yellow in Melzer's reagent.

The inner wall, which is hyaline, smooth, and 2-10 μm thick (Fig. 3), forms only after differentiation and complete formation of the outer and middle walls. A very thin outer layer (*iw-l* 1) and a thin inner layer (*iw-l* 3) appear to adhere to the finely laminated middle layer (*iw-l* 2) in water mounted specimens, but neither *iw-l* 1 nor *iw-l* 3 are usually detected in specimens mounted in PVLG.

The acaulosporoid appendix arises laterally from the hyphal neck of a sporiferous saccule, is often persistent, and resembles a subtending hypha, 30-100 μm long, 20-50 μm wide, cylindric or tapering to 10-25 μm at the distal end from the spore. The wall is continuous with the outer spore wall and with *mw-l* 1 (Fig. 2). The appendix pore is closed by a septum arising from *mw-l* 1 at or a short distance (0-5 μm) from the spore base (Fig. 2). Occasionally a second septum — less often a third — forms 20-50 μm further from the spore base in the appendix. When the septal closure of the pore is not seen, *mw-l* 2 closes the pore.

Acaulosporoid spores germinate with a single or branched germ tube, 6-12 μm in diameter, that emerges from the inner wall and exits through the pore of the appendix. A distinctive germination structure was also observed to form between middle and inner walls in a spore mounted in water from which a germ tube emerged (Fig. 5). Single or loose clusters of swollen hyphal tips often form on the germ hyphae at a short distance (100-200 μm) from the base of the acaulosporoid spore.

Glomoid spores—Hyaline to subhyaline, globose to subglobose, 120-240(-280) μm diam with spore wall (*sw*) consisting of a mucilaginous outer layer *sw-l* 1, 1.5-2.5 μm thick, frequently with adhering debris on the outer surface, and a 2-8(-12) μm thick, laminated inner wall layer (*sw-l* 2). Subtending hypha cylindric to slightly funnel shaped, 7-16(-19 μm) diam at the spore base tapering to 5-12

μm within a distance of 7-20(-30) μm . The bi-layered wall of subtending hypha totals 1.8-3.2 μm thick at the spore base. The pore usually is open, 5-10(-12) μm diam but sometimes a thin septum deriving from the inner hyphal wall layer is seen at a short distance (5-12 μm) from the spore base. Glomoid spores germinate through the subtending hypha.

Mycorrhiza formation—Forming mycorrhiza with arbuscles and vesicles (Fig. 6). Arbuscules, vesicles, and intraradical hyphae stain pale blue with trypan blue.

Discussion—In addition to the above glomoid spores, Schenck et al. (1984) described 'vesicle-like' structures, which we interpret as aborted glomoid spores, because they often accompany loose clusters of glomoid spores. These are thin-walled (1-2 μm), globose (40-80 μm) or ellipsoidal (68-120 x 54-112 μm) swollen hyphal tips that readily collapse when mounted in lactophenol or PVLG.

Distribution—Colombia: in acidic Oxisols under native pastures in Carimagua, Meta Province; under cassava in acidic Ultisols at CIAT Quilichao, at Agua Blanca and at Popayan, all Cauca Province. Florida-USA: isolated from acid soils (pH 5-5.5) near Gainesville and Ona. Costa Rica: reported by Johnson & Wedin (1997). Brazil: in Bahia and Goias found by J.L. Spain, and reported by Weber & Deoliveira (1994) and Carrenho et al. (1998, 2001). Bolivia: tropical forest (Oehl, unpublished). Venezuela: Gran Savanna region (G. Cuenca, pers. com.). Republic of Congo: under cassava in an acidic Oxisol in the South Kivu Region (Sieverding, unpublished). Mexico: agricultural land near Chapingo (Sieverding, unpublished). Thailand: tropical rain forest near Chiang Mai (Sieverding, unpublished). Namibia: reported by Uhlmann et al. (2004). Germany: in grasslands at St. Peter, Schwarzwald. Switzerland: in lowlands near Nenzlingen, mountainous grasslands near Sumvitg-Surrein, and subalpine grassland areas near Grindelwald and Realp (Oehl, unpublished).

SPECIMENS EXAMINED—**COLOMBIA**. Holotype specimen OSC #41,495 from a pot culture on *P. phaseoloides* at the Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia, inoculated with spores originally isolated from native grasses and tropical kudzu at Carimagua, Meta province, Colombia; spores from a pot experiment with cassava inoculated with pure holotype culture material, at CIAT, Cali, Colombia (Slides Nr. 3656-3658, Sieverding collection); spores from Carimagua, Meta, Colombia (Slides Nr. 1669 and 1670, Sieverding collection) and from Quilichao, Cauca, Colombia (slides Nr. 727-728, Sieverding collection); **BOLIVIA**. Spores from a pot culture at the Institute of Botany, University of Basel, Switzerland, inoculated with a natural forest soil derived from Estado Santa Cruz de la Sierra, Bolivia (slides Nr. 51-5101 and 51-5102, Oehl collection, deposited at Z+ZT). **SWITZERLAND**. Spores from high mountainous grasslands deriving from Sumvitg-Surrein, Kanton Graubünden (slides Nr. 51-5111 and 51-5112, Oehl-collection, deposited at Z+ZT).

Appendicispora gerdemannii (S.L. Rose, B.A. Daniels & Trappe) Spain, Oehl & Sieverd., *comb. nov.*

FIGURES 7-9

MB510321

Basionym: *Glomus gerdemannii* S.L. Rose, B.A. Daniels & Trappe, *Mycotaxon* 8, 297. January 13, 1979.

≡ *Archaeospora gerdemannii* (S.L. Rose, B.A. Daniels & Trappe) J.B. Morton & D. Redecker, *Mycologia* 93, 186-188. 2001.

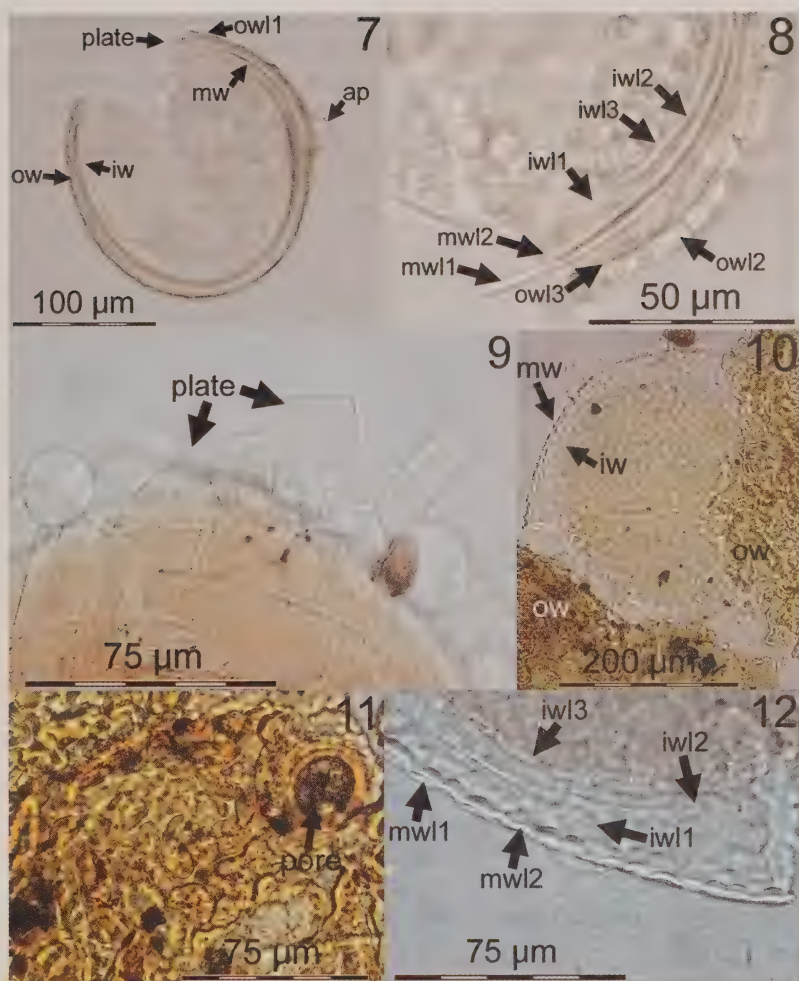
Spore formation—Sporocarps unknown. Acaulosporoid spores formed singly in the soil, glomoid spores formed singly or in loose clusters in the soil. Acaulosporoid spores arise from a single short appendix which forms on the tapering hyphal neck in some distance from the sporiferous saccule; glomoid spores formed on hyphae in the root external mycelium.

Sporiferous saccule—Globose to subglobose to rarely ellipsoid, 160-310 µm diam, formed terminally on a hypha. The saccule wall is bi-layered, hyaline to subhyaline, in total 3.0-7.0 µm thick. Hyphal neck 25-60 µm wide at the base of the saccule.

Acaulosporoid spores—Formed singly on an appendix (Fig. 7) which emerges from the hyphal neck of a sporiferous saccule. The spores have three walls (Fig. 8): The outer spore wall with three wall layers (*ow-l* 1, *ow-l* 2, *ow-l* 3; called L1 in figures 15-18 of Morton & Redecker 2001) that may sometimes totally be lost. The middle wall is bi-layered (*mw-l* 1 and *mw-l* 2; called L2 and L3 according to the above authors), the inner wall three-layered (*iw-l* 1, *iw-l* 2, *iw-l* 3; called L4 in Fig. 18 of Morton & Redecker 2001).

The *ow-l* 1 is evanescent, only present on young spores; *ow-l* 2 is easily seen, often showing a crazed surface (Fig. 8); *ow-l* 3 is difficult to discern because it is very thin and tightly pressed to *ow-l* 2. In young spores, *ow* and *mw-l* 1 are continuous with the appendix wall; *mw-l* 1 can produce several septa in the appendix. In mature spores where the appendix is broken off, a septum formed by *mw-l* 1 and *mw-l* 2 closes the pore at the appendix base. The fracturing character ('plate-like splitting') of *mw-l* 1 and *mw-l* 2 (Fig. 9) is shown in the holotype material. In some spores isolated from the field and mounted in PVLG, the middle wall was observed to crack in an irregular pattern, not 'plate-like'. The inner wall (*iw*) has three layers. The *iw-l* 1 and *iw-l* 3 are difficult to detect. They are often strongly adherent to the finely laminated *iw-l* 2 (Fig. 8). Germination of acaulosporoid spores of *Ap. gerdemannii* has not yet been observed.

Glomoid spores—Hyaline to subhyaline, globose to subglobose, 40-130 µm diam, with one spore wall (*sw*), consisting of a mucilaginous outer layer *sw-l* 1, about 0.8-1.0 µm thick, frequently with adhering debris on the outer surface; inner wall layer (*sw-l* 2) 1.5-4.0 µm thick, laminated. Subtending hypha cylindric to slightly funnel shaped, 6-13 µm diam at the spore base. Bi-layered



Figs. 7-9: *Appendicispora gerdemanni*. Fig. 7. Broken acaulosporoid spore formed on an appendix (ap) with outer wall (owl1 is arrowed), a middle wall (mw) with some plate-like structures, and an inner wall (iw). Fig. 8. Crushed acaulosporoid spore showing layers of the outer wall (owl2, owl3), middle wall (mwl1, mwl2) and inner wall (iwl1, iwl2, iwl3). Fig. 9. Plate like structures of the middle wall in broken acaulosporoid spore (photo taken from holotype material).

Figs. 10-12: *Appendicispora jimgerdemanni* (photos from holotype material called Achouri slides). Fig. 10. Broken acaulosporoid spore with outer wall (ow), middle wall (mw) and inner wall (iw). Fig. 11. Cerebriform folds of the outer wall of an acaulosporoid spore; pore of detached appendix visible. Fig. 12. Broken acaulosporoid spore - outer layer detached - with two layered alveolated middle wall (mwl1, mwl2) and three-layered inner wall (iwl1, iwl2, iwl3).

wall of subtending hypha is in total 1.4–2.5 μm thick at the spore base. The pore usually is open, but a thin septum deriving from the inner hyphal wall layer is sometimes visible in a short distance from the spore base. Germination of glomoid spores not observed.

Mycorrhiza formation—Described as being very similar to *Ap. appendicula* by Morton & Redecker (2001).

Discussion—In their recent explanation of spore structure and ontogeny, Morton & Redecker (2001) described a second acaulosporoid morph. However, we observe that the outer spore wall of the acaulosporoid spores of *Ap. appendicula* can flake off in the wet sieving process, which leads us to conclude that the same may occasionally happen in *Ap. gerdemannii*. Acaulosporoid spores lacking an outer wall may be wrongly interpreted to be a second acaulosporoid morph. Such spores can have remnants of the appendix whose wall is partly continuous with the middle wall. Morton & Redecker (2001) described the glomoid spores of *Ap. gerdemannii* as somewhat smaller than those of *Ap. appendicula*.

Distribution—This species is known or has been reported from United States (type location), from cultivated acidic soils in Colombia (Sieverding, unpublished) and the Republic of Congo, South Kiwu region (Sieverding, unpublished), and from lowland grasslands in France and Germany (Oehl, unpublished). In Switzerland, most frequently found in the Swiss Alps at 1900–2600 m a.s.l. (Oehl, unpublished).

SPECIMENS EXAMINED— **UNITED STATES. Oregon.** Type specimen OSC #39,476 isolated from Deschutes County. **FRANCE. Alsace.** Spores propagated in a trap culture of AMF communities derived from a decarbonated grassland at Wintzenheim-La Forge (slide Nr. 52-5201, Oehl-collection; deposited at Z+ZT); **SWITZERLAND.** Specimens isolated from a calcareous lowland grassland at Wildenbuch (ZH) and from several mountainous, subalpine and alpine sites in the Swiss Alps (slides Nr. 52-5211; 52-5212; 52-5213, Oehl-collection, deposited at Z+ZT).

Appendicispora jimgerdemannii (N.C. Schenck & T.H. Nicolson) Spain, Oehl & Sieverd., **nom. nov.** **FIGURES 10–12**

MB510322

Synonym: *Acaulospora gerdemannii* N.C. Schenck & T.H. Nicolson, Mycologia 71, 193. March 8, 1979.

Etymology: The new species name, *Appendicispora jimgerdemannii*, recognizes T.H. Nicolson's and N.C. Schenck's desire to honor the pioneer taxonomist of arbuscular mycorrhizal fungal species, Dr. Jim Gerdemann, who first described the ontogeny of sporiferous saccules and initial spore formation in the genus *Acaulospora*.

Spore formation—Sporocarps unknown. Acaulosporoid spores arise singly from a short appendix formed on the tapering hypha that terminates in a sporiferous saccule. Glomoid spores are as yet unknown.

Sporiferous saccule—Globose to ellipsoid, 290-365 μm diam, with a subhyaline to (light) brown wall that is 10-12 μm thick. The sporiferous saccule usually persists on young specimens, and it is described by Nicolson & Schenck (1979) as collapsing and detached from the spore after spore maturity.

Acaulosporoid spores—Globose to subglobose, 200-250 μm diam, brown at maturity. They arise singly from a thick-walled rigid appendix, 35-45 μm diam, which is formed on a tapering hypha that terminates in a sporiferous saccule. Acaulosporoid spores have three walls: an outer spore wall (*ow*), a middle wall (*mw*) and an inner wall (*iw*) (Fig. 10). The number of layers in the *ow* cannot readily be determined as all specimens investigated are observed in plan view. The main layer is brown in color, becoming brittle with age. It is approximately (8-)10-14 μm thick showing cerebriform folds (Fig. 11) over a laminated wall layer that is 1-1.5 μm thick. The cerebriform ridges are up to (6-)10-12 μm high and 4-6 μm broad and 1-3 μm apart from each other; the outer spore wall does not react with Melzer's reagent. The *ow* has an open pore, 15-25(-30) μm wide (Fig. 12). When the appendix is detached the pore is closed by the middle wall. The first author (JLS) interprets the middle wall as a single thin hyaline wall ornamented with an alveolate reticulum while the co-authors observed two layers in one spore of the type specimen (*mw-l* 1 and *mw-l* 2; Fig. 12). There, *mw-l* 2 is hyaline, finely laminated, 2-3.5 μm thick, tightly adherent to *mw-l* 1, thus showing the same alveolate structure as *mw-l* 1. The ornamentation is of concave hemispherical depressions, 7-10 μm wide on the outer *mw* surface, with convex protuberances of similar size on the inner *mw* surface (Fig. 12). The middle wall is yellow in Melzer's reagent. The *iw* is hyaline, smooth, 4-6 μm thick. The very thin outer layer (*iw-l* 1) and a very thin inner layer (*iw-l* 3) are difficult to discern (Fig. 12). Both layers are tightly adherent to the finely laminated middle layer (*iw-l* 2), hardly be observed in specimens mounted in PVLG. The *iw* does not stain in Melzer's reagent.

Glomoid spores—So far not yet found or attributed to *Ap. jimgerdemannii*.

Mycorrhiza formation—Forming vesicular-arbuscular mycorrhiza with "unlobed vesicles" (after Nicolson & Schenck, 1979).

Discussion—The notes on the morphology of the acaulosporoid spores of *Ap. jimgerdemannii* are based on the description of *Ac. gerdemannii* by Nicolson & Schenck (1979) and on our own observations of the type material. We also considered the observations of a specimen we isolated from the type location. In this study more acaulosporid spore walls and layers were identified than described by Nicolson & Schenck (1979). They described only those walls of the acaulosporoid spore which we call outer wall and middle wall. We admit that the morphological characterization of the species remains incomplete because of the lack of known living pot cultures.

Distribution—*Ap. jimgerdemannii* is known from USA and Switzerland (see specimens observed), and from Venezuela (Sieverding, unpublished).

SPECIMENS EXAMINED— **UNITED STATES. Florida.** Type specimen OSC #37,417 isolated from *Paspalum notatum* Flügge, at Ona, Florida, October 1977; isotype specimen isolated from the type location in June 2002; **SWITZERLAND. Valais. Grisons.** Specimen isolated from a field sample from Alp Nadels (1930 m a.s.l.), Kanton Graubünden, Switzerland, and from Le Cartogne (2580 m a.s.l.), Canton Valais, Switzerland (slides Nr. 53-5301 and 53-5311, Oehl-collection; deposited at Z+ZT).

Species excluded from the new genus

Archaeospora trappei (R.N. Ames & Linderman) J.B. Morton & D. Redecker, Mycologia 93, 183-184. 2001.

Basionym: *Ac. trappei* R.N. Ames & Linderman. Mycotaxon 3, 566. 1976.

Glomus leptotichum N.C. Schenck & G.S. Sm. Mycologia 74, 82-83. 1982.

= *Archaeospora leptoticha* (N.C. Schenck & G.S. Sm.) J.B. Morton & D. Redecker, Mycologia 93, 184-186. 2001.

Glomus fecundisporum N.C. Schenck & G.S. Sm. Mycologia 74, 81-82. 1982.

Discussion

Arbuscular mycorrhizal fungal species of the new genus *Appendicispora* can be distinguished morphologically from all other genera in the Glomeromycetes. At least two species of the new genus, *Ap. appendicula* and *Ap. gerdemannii*, are dimorphic. Mycorrhizal associations can produce both acaulosporoid and glomoid spores. We do not know whether *Ap. jimgerdemannii* is also dimorphic. Even if glomoid spores are not found or observed in samples, *Appendicispora* can easily be identified on the basis of various morphological characteristics of the acaulosporoid morph, as explained below. The formation of spores laterally on the neck of a sporiferous saccule hypha is known only for *Acaulospora* (Gerdemann & Trappe 1974) and for the acaulosporoid spores of *Archaeospora trappei* (Morton & Redecker 2001, Hafeel 2004). The glomoid morph forms terminally on a hypha as in the genera *Glomus* (Gerdemann & Trappe 1974), *Paraglomus* (Morton & Redecker 2001), *Pacispora* (Oehl & Sieverding 2004) and similar to the glomoid morph of *Ar. trappei*. *Appendicispora* spp. share this spore dimorphy only with the single member remaining in the genus *Archaeospora*: *Ar. trappei* which however rarely develops glomoid spores (Spain 2003).

Acaulosporoid spores in *Appendicispora* develop on an appendix that forms laterally on the neck of the sporiferous saccule (Fig. 1). In at least two species of the *Appendicispora*, *Ap. appendicula* and *Ap. gerdemannii*, the appendix wall is continuous not only with the outer spore wall, but also with the prominent outer layer of the middle wall of the spore, a feature unique in the attachments

between acaulosporoid spores and hypha of the Glomeromycetes. In contrast to this, only the outermost layer of the acaulosporoid spore of *Ar. trappei* is continuous with the connected spore bearing hypha (see Fig. 6 in Hafeel 2004). Although the outer spore wall and a layer of the middle wall may arise from the same hyphal and appendix wall, we consider them separate walls. These two walls (*ow* and *mw*) strongly differentiate during spore formation and the outer spore wall and the middle wall easily separate from each other in broken spores.

Germination of the acaulosporoid morph, so far known only from *Ap. appendicula* in the *Appendicispora*, is also unique in the Glomeromycetes. The germ tube emerges through the appendix. It is not known if all germination is from a germination structure formed between the middle and inner walls as was observed in a spore mounted in water (Fig. 5). Observations of spores mounted in PVLG have not elucidated such a germination structure but it is well known that PVLG and other mountants can alter such structures (germination orbs) of *Acaulospora* spp. enough to make them appear ephemeral (Spain 1992, Morton & Benny 1990). The novel germination structure found in *Ap. appendicula* is distinct from that of *Ar. trappei* and from the germination orbs of the *Acaulosporaceae* described by Spain (2003, 1992).

Appendicispora spp. form vesicular-arbuscular mycorrhiza (arbuscules, vesicles, and intra- and extraradical hyphae) that stain light or pale blue with standard methods using trypan blue as a dye (Fig. 6). Interestingly, the pale staining feature is not shared with any of the other genera forming vesicular-arbuscular mycorrhiza. Species of *Glomeraceae*, *Acaulosporaceae*, *Pacisporaceae* and *Entrophosporaceae*, so far as it is known for each species of these families, form mycorrhizal structures in roots that stain deep blue with trypan blue (Morton & Benny 1990, Oehl & Sieverding 2004; Sieverding & Oehl 2006). Mycorrhizal structures of the genera *Scutellospora* (Walker & Sanders 1986) and *Gigaspora* (Gerdemann & Trappe 1974) also stain dark blue but these two genera do not form intraradical vesicles (Morton & Benny 1990). In contrast, mycorrhizal structures of *Paraglomus*, *Archaeospora* and *Intraspora* spp. do not stain or stain only very faintly using trypan blue-based staining protocols, and species of these three genera are believed to not form or only rarely form intraradical vesicles (Morton & Redecker 2001, Sieverding & Oehl 2006).

The three species of the new genus can be easily distinguished from each other by the presence or absence of ornamentation on their spore walls. *Appendicispora jimgerdemannii* has two ornamented walls: a cerebriform outer wall and an alveolate middle wall. *Appendicispora appendicula* has a crazed outer wall and an alveolate middle wall. *Appendicispora gerdemannii* has three non-alveolated walls.

The new genus *Appendicispora* remains currently in the family of the *Archaeosporaceae* based on molecular data presented by Redecker et al. (2000). Further analyses of the genome on additional loci will be necessary to define whether the genus *Appendicispora* belongs to a new family.

Appendicispora spp. have frequently been reported from Mediterranean, subtropical and tropical climates (type locations; Weber & Deoliveira 1994, Johnson & Wedin 1997, Carrenho et al. 1998, 2002, Uhlmann et al. 2004, Wubet et al. 2004). This is in contrast to *Ar. trappei* reported from many different climates and ecosystems all over the world. Our recent studies, especially in the higher elevations of the Alps, reveal that *Appendicispora* spp. can be a common part of arbuscular mycorrhizal fungi communities in cold climates. We found all three species at high mountainous, subalpine and alpine elevations in Switzerland. There they were significantly more frequent and abundant, in spore and species numbers, than in the adjacent temperate Central European lowlands where they were rarely observed (Oehl et al. 2003; Wubet et al. 2003).

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Myxomycetes of Belgrad Forest (Istanbul)R. BATUR ORAN¹, C. CEM ERGÜL¹ & BASARAN DÜLGER²*ergulc@uludag.edu.tr*¹*Uludag University, Faculty of Arts and Sciences
16059, BURSA-TURKEY*²*Çanakkale Onsekiz Mart University, Faculty of Arts and Sciences
17100, ÇANAKKALE- TURKEY*

Abstract—Myxomycetes were collected in the Belgrad Forest, which is located near Istanbul in the Thrace region of Turkey, between February 2002 and January 2003. Sixty-two species of myxomycetes belonging to 21 genera were recorded from field and moist chamber culture collections. A map of the study area, material & method and the checklist are available at the website http://biyoloji.uludag.edu.tr/ergul/Checklist_003.pdf.

Key words— Balkan Peninsula, Myxobiota, systematics, slime moulds

Introduction

The Belgrad Forest covers an area of ca. 5300 hectares in the northern part of the Istanbul Peninsula in the European region of Marmara in the Bahçeköy District (28°54'–29°00'E, 41°09'–41°12'N) of Turkey. The area has a humid Mediterranean climate (Akman & Ketenoglu 1986). Relatively high annual precipitation around Bahçeköy allows for the development of the deciduous forest that is typical of the vegetation found in oceanic regions in Turkey (Kutluk & Aytuğ 2000). The Belgrad Forest is one of the most important forest areas in Istanbul and is included among the nine Turkish hot spots by the World Wildlife Fund (WWF1 & WWF2 2006). The flora of the Belgrad Forest is essentially Central European; 415 taxa have been recorded from the forest (Yaltırık 1966). The dominant tree genera are *Quercus*, *Castanea*, and *Carpinus*, with a lesser amount of *Fagus*. It is the only old-growth oak-beech natural forest near Istanbul. The forest includes many small streams and seven large aqueducts. The dense plant cover, high canopy, rich detrital material and high relative humidity found in the Belgrad Forest favor the development of myxomycetes. Comprehensive studies on myxomycetes of Anatolian Turkey have been carried out (Ergül et. al. 2005 a,b, Ocak & Hasenekoğlu 2005). In previous studies,

Arcyria cinerea and *Echinostelium minutum* (Härkönen 1987), *Amaurochaete atra* (Sümer 1982) and *Lycogala epidendrum* (Lohwag 1964) were recorded for the first time from the Belgrad Forest and the Bahçeköy District. Oran & Ergül (2004) added 23 species, all new records for Turkey, to the forest's myxobiota. Ergül & Oran (2005) found *Physarum pulcherrimum* in the Belgrad Forest, also a new record for Turkey. In the current study, 62 myxomycete species have been identified for the Belgrad Forest myxobiota.

Results

As a result of the collecting reported here, 62 myxomycete taxa are now known from the Belgrad Forest.

The order *Trichiales* is the best-represented group with 19 species, followed by the *Stemonitales* (16 species), *Liceales* (12 species), *Physarales* (11 species), *Echinosteliales* (3 species), and *Ceratiomyxales* (1 species). The most abundant genera are *Licea* (8 species), *Arcyria* (7 species), *Trichia* (6 species), *Physarum*, *Stemonitis* (each with 5 species), *Badhamia*, *Cribraria*, *Comatricha*, (each with 4 species), *Paradiacheopsis*, *Perichaena* (each with 3 species), and *Clastoderma* and *Stemonitopsis* (represented by two species each). Only a single species each was found for *Calomyxa*, *Ceratiomyxa*, *Diachea*, *Echinostelium*, *Enerthenema*, *Fuligo*, *Hemitrichia*, *Macbrideola*, and *Metatrichia*.

The moist chamber technique recovered 251 identifiable myxomycetes. In contrast, only 71 specimens were found sporulating in the field. The most commonly recovered species from Petri dish incubation were *Arcyria cinerea* (75 samples), *Perichaena corticalis* (27 samples), *Enerthenema papillatum* (26 samples), *Macbrideola cornea* (20 samples), and *Echinostelium minutum* (18 samples).

Genera represented by species found sporulating in the forest were *Arcyria* (21 samples), *Comatricha* (15 samples), *Cribraria* (10 samples), *Trichia* (7 samples), *Physarum* (3 samples), *Ceratiomyxa*, *Metatrichia*, *Stemonitis* (each with 3 samples), *Fuligo* (2 samples), *Badhamia*, *Diachea*, *Hemitrichia*, and *Stemonitopsis* (each with 1 sample). Only five samples of *A. cinerea* were found sporulating in nature whereas seventy-five specimens were recovered from moist chambers.

The myxomycetes most commonly found in the field included *A. cinerea* (5 collections), *A. ferruginea* (5), *A. incarnata*, *A. obvellata* (each 3), *A. denudata*, *A. minuta* (each 2), *A. versicolor* (1); *Comatricha laxa*, *C. nigra* (each 6), *C. ellae* (2), *C. tenerrima* (1); *Cribraria aurantiaca* (7), *C. cancellata* (2), *C. microcarpa* (1); *Trichia botrytis* (4), *T. contorta*, *T. decipiens*, *T. varia* (each 1), *Physarum album* (2) and *P. flavicomum* and *P. viride* (each 1). Additional species included: *Ceratiomyxa fruticulosa*, *Metatrichia vesparium* (each 3), *Stemonitis axifera*, *S. fusca* and *S. smithii* (each 1), *Fuligo septica* (2) and one each of *Badhamia*

versicolor, *Diachea leucopodia*, *Hemitrichia calyculata* and *Stemonitopsis typhina*.

Discussion

The high recovery of the corticolous species *Arcyria cinerea* demonstrates high germination potential of its spores, effective dissemination, and its likely adaptation to the dark and moist conditions of the Belgrad Forest. Seasonal occurrence of myxomycete fructifications is moisture dependent (Mitchell et al. 1980). According to Schnittler (2006) myxomycetes are well adapted to fluctuating moisture in the environment. Moist conditions favor development of the amoebal and plasmodial stages, and dry conditions facilitate spore dispersal. This, along with the formation of durable dormant stages, enables myxomycetes to respond rapidly to temporally and spatially changing microhabitats. The high, closed forest canopy contributes to retention of free and atmospheric water in the forest. The substratum, light intensity, temperature, soil characteristics and moisture are factors that influence the occurrence and abundance of myxomycetes (Ing 1994, Schnittler & Novozhilov 1996).

Twenty-nine species of myxomycetes were recovered from bark of *Quercus* incubated in moist chambers, making it the most productive source on myxomycetes of the Belgrad Forest. A much lower number of species were recovered from other angiospermous bark, including *Alnus glutinosa* (5 species), *Acacia* sp. (4), *Carpinus betulus*, *Castanea sativa*, *Pinus* spp., *Tilia* sp. (3 species each), *Aesculus hippocastanum*, *Cupressus* sp., *Cedrus* sp., *Platanus orientalis* (2 species each). No myxomycetes were recovered from incubated bark of species of *Acer* or *Pyrus*. The lower numbers of recovered myxomycete species from bark of genera other than *Quercus* could be due to the fact that for members of each genus the bark is smooth and free of epiphytic bryophytes and lichens. The relative abundance of epiphytes can vary greatly among different types of trees, this factor would seem to have considerable potential for affecting the distribution patterns of corticolous myxomycetes (Stephenson & Stempen 1994). Harkönen et al. (2004) concluded that smooth, basic bark has a low water holding capacity and supported low diversity of myxomycetes, bryophytes and lichens. High water holding capacities may be directly beneficial for corticolous myxomycetes as their active plasmodia are highly dependent on the availability of liquid water. Moreover, Harkönen et al. (2004) concluded that high epiphyte cover did not act to increase diversity of corticolous myxomycetes. Stephenson (1989) concluded that considerable variation exists for the bark microhabitats potentially available for corticolous myxomycetes.

Different tree species exhibit a wide range of variation in the surface physical characteristics of bark (usually referred to as bark texture), with some trees exhibiting relatively smooth bark and others having furrowed and rather rough

bark. McHugh (1998) noted that individual *Quercus* species and *Quercus* forests are the most productive sources for myxomycetes. Spores of some myxomycetes require an exogenous source of carbon or nitrogen for their production of sporocarps (Moore-Landecker 1996). Distribution patterns of myxomycetes can be explained by a combination of both microhabitat and macroclimate requirements (Schnittler 2006).

The closed canopy of the Belgrad Forest limits incident sunlight on the forest floor and retains moisture as free water and high humidity. These physical factors, along with high plant diversity, which is especially rich in *Quercus cerris* and *Q. frainetto*, contribute to an abundant myxomycete biota for the Belgrad Forest.

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**The anamorph of *Erysiphe platani* on
Platanus ×hispanica in Slovakia**

KATARÍNA PASTIRČÁKOVÁ^a & MARTIN PASTIRČÁK^b

nruekpas@savba.sk

^a *Institute of Forest Ecology, Branch of Woody Plants Biology, Slovak Academy of Sciences,
Akademická 2, SK-94901 Nitra, Slovakia*

^b *Department of Genetics of Resistance, Research Institute of Plant Production,
Bratislavská cesta 122, SK-92168 Piešťany, Slovakia*

Abstract—A species of powdery mildew new for the Slovak mycoflora, *Erysiphe platani*, which parasitizes on plane trees, is reported. Disease symptoms and morphological characteristics of the anamorph are described. No teleomorph was observed.

Key words—introduced powdery mildew disease, plane trees, hyperparasite

Introduction

Erysiphe platani (syn. *Microsphaera platani*) is a common North American powdery mildew species, widespread on *Platanus occidentalis* L., *P. orientalis* L., *P. ×hispanica* Münchh. (syn. *P. acerifolia* (Ait.) Willd., *P. hybrida* Brot.), *P. racemosa* Nutt. and *P. wrightii* S. Wats. (Hirata 1966, Gorter & Eicker 1985, Braun 1995). This fungus causes deformation and growth reduction of young leaves and shoots of *Platanus* spp. E.C. Howe observed the teleomorph of this fungus for the first time on *Platanus* in the United States in the autumn of 1874. A description of the anamorph was published later by Sumstine (1941). *Erysiphe platani* attacks *Platanus* species in North America (Howe 1874, Sumstine 1941, Hirata 1966, Glawe 2003) and has been introduced in South America, South Africa, Europe, Asia, Australia and New Zealand. Ciferri & Camera (1962) and Gullino & Rapetti (1978) published first records of this fungus from Europe (Italy) on *P. occidentalis* and *P. hybrida*, respectively. The epidemic spread of this North American pathogen has already been reported from Portugal (Sequeira 1981), Romania (Eliade 1985), Montenegro (Mijušković 1993, Ranković 2003), Bulgaria (Fakirova 1985), France (Gullino & Rapetti 1978, Viennot-Bourgin 1982), Spain (Tello et al. 2000), Russia (Golovin 1956), Israel (Halperin 1989), Argentina (Klingner 1982, Braun et al. 2000), Chile (Luisi & San Martin 1987),

Australia (Cunnington 2003) and New Zealand (Boesewinkel 1986). *Erysiphe platani* also was reported (Gorter & Eicker 1985) infecting the leaves of *P. wrightii* in South Africa. Its occurrence was noticed on *P. orientalis* and *P. orientalis* var. *cretica* Dode in several areas in Greece by Pantidou (1973) and Vakalounakis & Klironomou (1995). Anselmi et al. (1994) mapped the incidence of *Erysiphe platani* in European and Mediterranean countries. They (Anselmi et al. 1994) observed differences in susceptibility of *Platanus* species to this pathogen in Europe. Ialongo (1981) suggested that there is a clonal specialization of this fungal species based on the results of its artificial inoculation.

A powdery mildew was collected from London plane tree (*P. ×hispanica*) in Nitra, Slovakia. We determined the causal agent to be the anamorphic state of *Erysiphe platani*. The teleomorph was absent but the anamorph morphology was identical with that described for *Erysiphe platani*. The teleomorph previously was recorded and described by Golovin (1956), Braun (1995), Ranković (2003) and Glawe (2003). This report documents the occurrence of *Erysiphe platani* on *P. ×hispanica* in Slovakia for the first time, and presents information on the taxonomy and identification of this fungus.

Materials and methods

Leaf samples from *P. ×hispanica* with symptoms of a powdery mildew disease were collected in November 2004. The morphological characteristics of *Erysiphe platani* were examined from fresh material. Observation and measuring were made using a standard light microscope (JENAMED2, Carl Zeiss Jena). Measurements of microscopic features were made from slide preparations stained in lactophenol cotton blue. Our measurements correspond to previously published descriptions (Table 1). The fungus was photographically documented using a digital camera Olympus CAMEDIA model C-4000 ZOOM. Representative material was deposited in the mycological herbarium of the Institute of Forest Ecology SAS in Nitra, Slovakia.

Taxonomic description

Erysiphe platani (Howe) U. Braun & S. Takam., Schlechtendalia 4: 12, 2000

Basionym: *Microsphaera platani* Howe, Bull. Torrey Bot. Club 5: 4, 1874

Synonym: *Microsphaera alni* auct. p.p., *Microsphaera penicillata* auct. p.p.

Material examined – Slovakia. Nitra, city district Chrenova, tree-lined avenue, lat: 48°18'15" N, lon: 18°05'58" E, on living leaves of *Platanus ×hispanica*, 3 Nov. 2004, leg. K. Pastirčáková (anamorph, parasited by *Ampelomyces quisqualis*).

Symptoms – Mycelium superficial on both sides of young and older leaves, forming white to gray patches, also on petioles and inflorescences. Affected leaves often distorted, but not showing defoliation.



Figure 1. Anamorph of *Erysiphe platani*. (A, B) Conidiophores, (C) Primary conidia, (D) Secondary conidia, (E) Pycnidium of *Ampelomyces quisqualis*, (F) An intracellular hypha of *Ampelomyces quisqualis* growing out from the powdery mildew mycelium. Scale bars = 20 µm.

Microscopic features – Anamorph of *Oidium* (*Pseudoidium*) type. Mycelium amphigenous, dense, white, branched, interwoven; hyphae hyaline, smooth, 5-8 µm wide, penetrating through stomata. Appressoria abundant, lobed. Conidiophores erect, 1-3-septate, hyaline, 90-220 × 7-10 µm, foot-cells straight to flexuous or curved, followed by 1-3 mostly shorter cells. Primary conidia with rounded apex and subtruncate base, 28.5-43 × 14-20 µm. Secondary conidia formed singly, sporadically adhering in chains of 2 to 3, hyaline, ellipsoid to doliiform, with slightly convex symmetric ends, measuring 30-48 × 15.5-22 µm. Boesewinkel (1986) observed extremely long conidiophores, occasionally branched, producing huge conidia. Unusual conidial germination, where the germ tube resembled cleistothecial appendages, was noticed.

On the basis of our measurements of the anamorph and the literature data (Table 1) we identified the fungus as *Erysiphe platani*. This is the first record of this powdery mildew species in Slovakia. Anselmi et al. (1994) stated that the teleomorph had not detected in Europe, but Golovin (1956) and Ranković (2003) recorded mature ascomata (chasmothecia) in Russia and Montenegro, respectively.

We also recorded the hyperparasitic fungus *Ampelomyces quisqualis* Ces. ex Schltdl. (syn. *Cicinobolus cesatii* de Bary) on *Erysiphe platani*. *Ampelomyces quisqualis* was abundant on mycelium and conidiophores of our material. *Ampelomyces quisqualis* may have prevented the formation of ascomata. Himelick & Neely (1959), Scarito Bongarrà (1981) and Eliade (1985) also

Table 1. Biometric characteristics of *Erysiphe platani* (*M. platani* and its other synonyms) on *Platanus* sp. reported by other authors and of the Slovak material examined (μm).

	Conidia	Conidiophores	Ascomata	Asci	Ascospores
Burrill & Earle (1887)	not stated	not stated	80-130	*	20 μm long
Sumstine (1941)	30-50 $\times$ 15-20	*	*	*	*
Golovin (1956)	not stated	not stated	75-96	51-63 $\times$ 33-48	21-33 $\times$ 12-18
Gullino & Rapetti (1978)	36.8-37.9 $\times$ 18.1-19.7	*	absent	absent	absent
Ialongo (1981)	28-51 $\times$ 16-25	*	absent	absent	absent
Lorenzini & Triolo (1981)	31-49 $\times$ 15-25	140 $\times$ 7.5	absent	absent	absent
Scarito Bongarrà (1981)	31.7-46.8 $\times$ 15.1-22.6	105.7-181.2 $\times$ 6.04-9.06	absent	absent	absent
Sequeira (1981)	30-40 $\times$ 15-17	170	absent	absent	absent
Klingner (1982)	35-51 $\times$ 18-22	131-286 $\times$ 7-10	absent	absent	absent
Eliade (1985)	32-34 $\times$ 12-16	*	absent	absent	absent
Fakirova (1985)	23-48 $\times$ 12-20	*	absent	absent	absent
Gortler & Eicker (1985)	30-45 $\times$ 15-22.5	70-180 $\times$ 6.1-11.2	absent	absent	absent
Boesewinkel (1986)	35-45 $\times$ 15-22	62-205 (250-500) $\times$ 6.5-9	absent	absent	absent
Marziano et al. (1986)	34-46 $\times$ 15-21	70-250	absent	absent	absent
Luisi & San Martin (1987)	31.4-39.6 $\times$ 15.0-22.4	109.2 $\times$ 10.4	absent	absent	absent
Mijušković (1993)	28.1-39.6 $\times$ 13.2-19.8	110-175	absent	absent	absent
Braun (1995)	25-50 $\times$ 14-22.5	*	absent	absent	absent
Vakalounakis & Klironomou (1995)	30.3-50.8 $\times$ 15.7-20.6	*	80-115	40-60 $\times$ 30-50	18-25 $\times$ 12-16
Sammarco & Torta (1997)	22.5-47 $\times$ 15-30	*	absent	absent	absent
Glawe (2003)	19-35 $\times$ 10-21	*	absent	absent	absent
Ranković (2003)	28-48 $\times$ 14-24	*	54-118	35-53 $\times$ 31-42	14-23.5 $\times$ 12-21
Slovak material	30-48 $\times$ 15.5-22	90-220 $\times$ 7-10	80-110	43-62 $\times$ 33-50	18-24 $\times$ 12-16
			absent	absent	absent

* microstructures were observed without recording their size

noticed the occurrence of this hyperparasite on *Erysiphe platani*. It infects and forms pycnidia within *Erysiphe platani* hyphae and conidiophores. This parasite reduces growth and may eventually kill the powdery mildew colony. The parasitic activity of every single fungal species on host plants is presented as total weakening of its vitality, decreasing of resistance to harmful agents, reduction of growing period of affected organs (leaves). *Ampelomyces quisqualis* has been the subject of numerous investigations on biological control of powdery mildews for over 50 years.

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Evaluation of characters available from herbarium vouchers for the phylogeny of the downy mildew genera (Chromista, *Peronosporales*), with focus on scanning electron microscopy

MARCO THINES

thines@uni-hohenheim.de

*University of Hohenheim, Institute of Botany (210)
Garbenstr. 30, 70599 Stuttgart, Germany*

Abstract—During the past five years numerous molecular phylogenies of the downy mildews have been computed. However, basic relationships of the *Peronosporaceae* are largely unknown because molecular phylogenies are partly contradicting or do not exhibit sufficient resolution. In this study, all genera of the downy mildews with lasting sporangiophores, which have been classified as belonging to the *Peronosporaceae*, have been investigated. Ultrastructural synapomorphies for the genera and groups of genera are presented. Especially the fine structure of the ultimate branchlets and haustorium morphology proved to be a suitable tool to differentiate between groups of genera, whereas the commonly used criteria of branching complexity or sporangial germination did not.

Key words—DMPH, ultrastructure, taxonomy, evolution

Introduction

The downy mildews (*Peronosporaceae*) are obligate biotrophic parasites of Angiospermae. Due to their osmotrophic way of nutrition and their hyphal growth, they were classified as belonging to the Mycota until the seventies of the past century, when several discrepancies of this classification were discovered (Manton 1965, Dick 1969; for review, see Dick 1997). In recent classifications, the downy mildews have been placed within the order *Peronosporales* of the *Peronosporomycetes* (Dick 2001a). The *Peronosporomycetes* (oomycetes) belong to the kingdom Chromista (Cavalier-Smith 1986), which should be given preference over the later-described, smaller kingdom, Straminipila (Dick 2001a), especially because recent investigations (Yoon et al. 2002, Andersson & Roger 2002, Bhattacharya et al. 2003, Harper & Keeling 2003, Keeling 2004) have provided evidence that the oomycetes stem from a photosynthetic ancestor.

The first downy mildew genus, *Peronospora* Corda was described in 1837 (Corda 1837) and was later classified in *Peronosporaceae* (de Bary 1863). During the following 40 years, two more genera (*Bremia* Regel (1843) and *Basidiophora* Roze & Cornu (1869)) were described, mainly on grounds of differences in conidiophore morphology. In 1879, the genus *Sclerospora* J. Schröt. (1879) was described, which was placed within the *Sclerosporaceae* by Dick et al. (1984) because of peculiarities in oospore formation (Dick 1995, Dick et al. 1999, Dick 2001b) and the fact that sporangiophores, as in the related genera *Peronosclerospora* (S. Ito) Hara (Shirai & Hara 1927) and *Sclerophthora* (Sacc.) Thirum. et al. (Thirumalachar et al. 1953), are evanescent (Schröter 1879, Kenneth 1981, Spencer & Dick 2002). Although *Sclerospora* has unequivocally been placed within *Peronosporaceae* in the molecular trees of Riethmüller et al. (2002), Göker et al. (2003), Voglmayr et al. (2004) and Thines et al. (2006), the genera previously assigned to *Sclerosporaceae* have been excluded from this study, also because their sporangiophores are often not preserved on herbarium vouchers.

Before molecular phylogenetic tools were used to study downy mildew phylogeny, eight additional genera of the *Peronosporaceae* were described: *Plasmopara* J. Schröt. (1886), *Pseudoperonospora* Rostovzev (1903), *Rhysotheca* G.W. Wilson (Wilson 1907), *Bremiella* G.W. Wilson (Wilson 1914), *Pseudoplasmopara* Sawada (Sawada 1922), *Paraperonospora* Constant. (Constantinescu 1989) and *Benua* Constant. (Constantinescu 1998). However, *Pseudoplasmopara* and *Rhysotheca* never gained broad acceptance. From the description of *Plasmopara* onwards, the distinguishing features of the newly described genera became more and more subtle and were subject to debate (Skalický 1966). This is reflected by confusing shifts of several taxa to different genera, which still last on into recent years (for reference see Constantinescu (1989) and Yu (1998))

Since the first molecular phylogenetic investigations in the *Peronosporaceae* (Cooke et al. 2000, 2002; Riethmüller et al. 2002; Constantinescu & Fatehi 2002), it became apparent that multiple taxa in the *Peronosporaceae* were in fact polyphyletic or paraphyletic, which was confirmed by subsequent studies (Choi et al. 2003, 2005; Göker et al. 2003, 2004; Voglmayr et al. 2004; Constantinescu et al. 2005; Thines et al. 2006). As a result, six new genera were described in the *Peronosporaceae* (*Graminivora* Thines & Göker, *Hyaloperonospora* Constant., *Perofascia* Constant., *Plasmoverna* Constant. et al., *Protobremia* Voglmayr et al. and *Viennotia* Göker et al.) and the genera *Rhysotheca* and *Bremiella* were relegated to synonymy with *Plasmopara*. In all cases, molecular phylogenetic investigations helped to confirm synapomorphies or morphological characters for differentiation of the newly described genera.

However, above the generic level, such synapomorphies have only seldom been sought after (Voglmayr et al. 2004). Transmission electron microscopy (TEM) and scanning electron microscopy (SEM) have proven to show interesting characteristics of the downy mildews and related organisms (Baretto & Dick 1991, Beakes et al. 1995, Bouterige et al. 2003, Constantinescu 2000, Falloon & Sutherland 1996, Lange et al. 1989, Michelmores et al. 1982, Mims 1991, Royle & Thomas 1971, Sargent 1981, Virányi & Henstra 1976). However, although Hall (1996) pointed to the possible usefulness of ultrastructural characters for classification and taxonomy, no efforts have so far been taken to evaluate the use of TEM or SEM for systematic studies on a broad array of taxa. The use of SEM for this purpose is evaluated here, because SEM investigations can be conducted easily on herbarised material and have already proven to reveal unknown characters in previous studies (Spring & Thines 2004, Thines & Spring 2005, Constantinescu et al. 2005). It is the aim of this study to reveal synapomorphies for the downy mildew genera by evaluating known and new characters of the downy mildews in the light of recent molecular phylogenies.

Materials and Methods

Sample preparation, scanning electron microscopy (SEM) and data analysis

For SEM, approximately 0.1 cm² of leaf tissue covered with sporangiophores was taken from herbarium vouchers and was mounted on aluminium object holders. After desiccation in a desiccator for two days, samples were sputtered and examined as described previously (Constantinescu et al. 2005).

For Neighbor-joining (Saitou & Nei 1987) analysis, the Mega2 program (Kumar et al. 2002) was used. Distance matrices were calculated using the formula of Jaccard (1908).

Specimens examined

Of 175 specimens examined (*Bremia* 15, *Graminivora* 5, *Hyaloperonospora* 11, *Paraperonospora* 6, *Perofascia* 2, *Peronospora* 40, *Plasmopara* 58, *Plasmoverna* 24, *Protobremia* 3, *Pseudoperonospora* 10, *Viennotia* 1) only those depicted in this study are listed in Table 1 on page 198.

Results

General description of morphological and ultrastructural features observed in the downy mildews

Several features become visible in SEM, such as the presence (Fig. 1M) or absence (Figs. 1J-L) of an annulus at the apical end of the ultimate branchlets, or the area of aggregated structures around the pedicels, which is especially prominent in species of *Bremia* (Fig. 1S) and other Downy Mildews with

Table 1. Peronosporomycete material depicted.

Species	Host	Origin; Collector; Year	Herbarium	Fig.##
<i>Basidiophora entospora</i> Roze & Cornu	<i>Conyza canadensis</i> (L.) Cronquist.	Germany, Bayrischer Wald, Helmberg; leg. Poelt; 1965	GZU 43-82	1
<i>Benua kellermanii</i> (Swingle ex Sacc.) Constant.	<i>Cyclachaena</i> <i>xanthiifolia</i> (Nutt.) Fresen.	Moldavia, Lăpușna; leg. Negrean, 1993	BUCM 127.045	2
<i>Bremia lactucae</i> Regel	<i>Lactuca serriola</i> L.	Germany, Ostfildern- Scharnhausen; leg. Thines; 2002	HUH 497	3
<i>Graminivora graminicola</i> (Naumov) Thines & Göker	<i>Arthraxon hispidus</i> (Thunb.) Makino	China; leg. anonymous; 1979	YAU	4
<i>Hyaloperonospora</i> <i>parasitica</i> (Pers.) Constant.	<i>Capsella bursa-</i> <i>pastoris</i> (L.) Medik.	Germany, Stuttgart-Asemwald; leg. Thines; 2002	HUH 503	5
<i>Hyaloperonospora</i> <i>thlaspeos-arvensis</i> (Gäum.) Göker et al.	<i>Thlaspi arvense</i> L.	Germany, Stuttgart- Hohenheim; leg. Thines; 2002	HUH 506	6
<i>Paraperonospora</i> <i>leptosperma</i> (de Bary) Constant.	<i>Tripleurospermum</i> <i>inodorum</i> (L.) Sch.-Bip.	Germany, Filderstadt- Bernhausen; leg. Thines; 2002	HUH 512	7
<i>Paraperonospora tanacetii</i> (Gäum.) Constant.	<i>Tanacetum vulgare</i> L.	Fennia, Revonlahti; leg. Laila & Roivainen; 1961	BR Myc 080875,74	8
<i>Perofascia lepidii</i> (McAlpine) Constant.	<i>Ledidium ruderales</i> L.	Germany, Wendelsheim, near Nebra; leg. Richter & Jage; 2001	TUB 012413	9
<i>Peronospora</i> <i>conglomerata</i> Fuckel	<i>Erodium cicutarium</i> (L.) L'Hér.	Austria, Schandau; leg. Krieger; 1907	GZU	10
<i>Peronospora destructor</i> (Berk.) Fr.	<i>Allium cepa</i> L.	Austria, Raasdorf; leg. anonymous; 1999	HUH 767	11
<i>Peronospora farinosa</i> (Fr.) Fr.	<i>Chenopodium</i> <i>album</i> L.	Germany, Filderstadt- Bernhausen; leg. Spring; 2002	HUH 518	12
<i>Peronospora rumicis</i> Corda	<i>Rumex acetosa</i> L.	Germany, Sonnenbühl; leg. Thines; 2005	HUH 806	13
<i>Peronospora tabacina</i> D.B. Adam	<i>Nicotiana tabacum</i> L.	Germany, Neuried-Altenheim, Fels; leg. Schwär; 2002	HUH 483	14
<i>Plasmopara epilobii</i> (G.H. Otth) J. Schröt.	<i>Epilobium</i> <i>parviflorum</i> Schreb.	Germany, Dahmsdorf; leg. H. Sydow; 1938	BR Myc 082206,47	15
<i>Plasmopara halstedii</i> (Farl.) Berl. & De Toni s.l.	<i>Helianthus annuus</i> L.	Laboratory strain; leg. Zipper; 2003	HUH 114	16
<i>Plasmopara nivea</i> (Unger) J. Schröt.	<i>Aegopodium</i> <i>podagraria</i> L.	Germany, Tübingen, Steinenberg; leg. Spring; 2002	HUH 452	17
<i>Plasmopara nivea</i> (Unger) J. Schröt.	<i>Aegopodium</i> <i>podagraria</i> L.	Belgium, Brabant, Boitsfort; leg. Beeli; 1916	BR Myc 082210,51	18
<i>Plasmopara pusilla</i> (de Bary) J. Schröt.	<i>Geranium pratense</i> L.	Germany, Esslingen- Kappishäusern; leg. Spring; 2002	HUH 477	20

Table 1, concluded

Species	Host	Origin; Collector; Year	Herbarium	Fig. #*
<i>Plasmopara ribicola</i> J. Schröt.	<i>Ribes rubrum</i> L.	Germany, München-Sendling; leg. Schnabl; 1892	GZU 253	21
<i>Plasmoverna isopyrithalictroides</i> (Sävul. & Rayss) Constant. et al.	<i>Isopyrum thalictroides</i> L.	Austria, Lower Austria, Mannersdorf; leg. Voglmayr; 2000	WU	22
<i>Plasmoverna pygmaea</i> (Unger) Constant. et al.	<i>Anemone nemorosa</i> L.	Belgium, Namur, Rhisnes; leg. Bommer & Rousseau; 1901	BR Myc 082338,82	23
<i>Plasmoverna pygmaea</i> (Unger) Constant. et al.	<i>Anemone sulphurea</i> L.	Austria, Graubünden; leg. Müller; 1970	GZU 281-81	24
<i>Protobremia sphaerosperma</i> (Sävul.) Voglmayr et al.	<i>Tragopogon pratensis</i> L.	Germany, Sonnenbühl-Undingen; leg. Thines; 2005	HUH 720	25
<i>Pseudoperonospora cubensis</i> (Berk. & M.A. Curtis) Rostovzev	<i>Cucumis sativus</i> L.	Germany, Niederstotzingen; leg. Spring; 2002	HUH 493	26

* Fig. # refers to the numbers in the figure captions.

Pyriform Haustoria (DMPH). In search for characters useful for classification and systematics of the downy mildews, the following structures were evaluated: morphology of the two last ramifications (Figs. 1A, B), mode of ramification for the ultimate branchlets (Figs. 1C-E), morphology of the ultimate branchlets (Figs. 1F-M), anatomy of the site where the ultimate branchlets were attached to the sporangia (Figs. 1N-P), ornamentation of the sporangia at this zone (Figs. 1Q-S) and formation of a wall at the apical end of the sporangia, which is structurally different, compared to the rest of the sporangium wall (Figs. 1T (present) and 1U (absent)). The morphology of the branches at the two last ramifications can either show a distinct broadening towards the point of ramification (Fig. 1A) or not (Fig. 1B). In *Paraperonospora*, the broadening is clearly visible (Constantinescu 1989), whereas in others it is less evident, for example in *Bremia*, *Protobremia* and *Basidiophora*.

A feature also easily accessible in LM is the mode of ramification of the ultimate branchlets. They can be dichotomously branched (Fig. 1C), pseudotrictotomous or trichotomous (Fig. 1D), be irregularly aggregated, as shown in Fig. 1E or regularly aggregated, as shown in Fig. 1I).

The ultimate branchlets can be variously shaped: straight (Fig. 1F), curved (Fig. 1G) and spiral (Fig. 1H). In *Benua*, no distinct ultimate branchlets are formed (Fig. 1I). The apical end of the ultimate branchlets can either be conical and acute (Fig. 1J), conical and truncate (Fig. 1K), tubular and truncate (Fig. 1L) or tubular and truncate with a distinct annulus (or distal broadening) and the covering wall caving in (Fig. 1M).

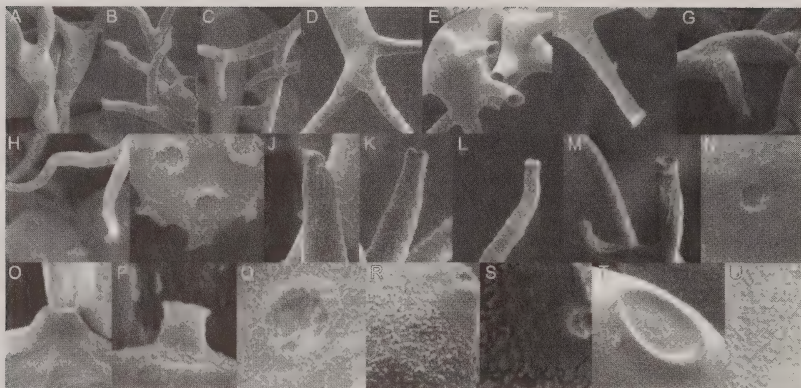


Figure 1. Ultrastructural characters in SEM. A, broadening of the sporangiophores towards the ramifications, as seen in *Paraperonospora tanacetii* (8); B, sporangiophores which do not exhibit a broadening of the sporangiophores towards the ramifications in *Hyaloperonospora parasitica* (6); C, dichotomous branching in *Peronospora destructor* (11); D, pseudotrictotomous branching in *Plasmopara nivea* (17); E, irregular aggregation of ultimate branchlets in *Plasmoverna pygmaea* (24); F, straight ultimate branchlets in *Pl. epilobii* (15); G, curved ultimate branchlets in *Pe. conglomerata* (10); H, spiral ultimate branchlets in *H. parasitica* (5); I, reduced ultimate branchlets in *Benuea kellermanii* (2); J, acute, conical ultimate branchlet in *Pe. farinosa* (12), K, truncate, conical ultimate branchlet in *Pe. tabacina* (14); L, truncate, tubular ultimate branchlet without annulus in *H. thlaspeos-arvensis* (6); M, truncate, tubular ultimate branchlet with distinct annulus and caving in wall in *Pl. halstedii* (16); N, flat "pedicel" in *Pe. conglomerata* (10); O, conical pedicel in *Pl. ribicola* (21); P, tubular pedicel in *Pl. nivea* (18); Q, ornamentation pattern without area of aggregated protuberances around the pedicel in *Pv. isopyri-thalictroides* (22); R, area of aggregated protuberances around the pedicel less elevated than remaining protuberances in *Pseudoperonospora cubensis* (23); S, area of aggregated protuberances around the pedicel in *Pl. pusilla* (20); T, papilla clearly visible in *Pl. halstedii* (16); U, no papilla visible in SEM in *Bremia lactucae* (3). Numbers in brackets refer to Fig. # in Table 1 (collection details).

The pedicels of the sporangia are another feature which might be considered for systematic studies of the *Peronosporaceae*. It can be absent (Fig. 1N) or even be replaced by a bowl-like structure (Fig. 1Q), be conical (Fig. 1O) or regular to irregular tubular (Fig. 1P). The surface ornamentation around the pedicel can also be characteristic and either be similar to the rest of the sporangium (Fig. 1Q), form a contiguous plate, which is less elevated than the protuberances of the sporangial surface elsewhere (Fig. 1R) or show an aggregation of protuberances, often leading to a contiguous plate which protrudes from the sporangial surface at the same height as the protuberances (Fig. 1S). The protuberances can be variously shaped, from rounded warts (Fig. 1R) to flattened irregular structures as in Fig. 1S.

The presence (Fig. 1T) or absence (Fig. 1U) of a wall thinning at the apical end—through which, after lysis, zoospores are released or a germ tube emerges—can be observed, because this structure caves in more readily than the

surrounding wall when sporangia dehydrate. If this structure, which is usually termed "papilla", becomes similar in thickness in comparison to the rest of the sporangial wall, it does not cave in so readily as in Fig. 1T, but only forms a portion of the sporangial wall, which is usually more flattened than the rest of it.

Ultrastructural characteristics of the downy mildew genera

In the following, the characters easily accessible in SEM are given for each of the genera of the *Peronosporaceae*, except for *Viennotia*, which was only studied in LM, because only microscopic slides were available. For each of the genera, the characteristics of the type species are given as a representative for the whole genus. Where the characteristics within the genus are highly variable, additional information is given for several species.

In *Basidiophora entospora* Roze & Cornu (Roze & Cornu 1869), the sporangiophores are mostly unbranched. If the sporangiophores show ramification, the sporangiophore trunk is broadened towards it. The ultimate branchlets are regularly aggregated (cephaloid), straight, tubular and with a distinct annulus at their distal ends and a covering wall caving in (Fig. 2A). The pedicels are mostly tubular (Fig. 2B). A 3-6 μm in diameter area of aggregated protuberances is present around the pedicel. Protuberances are less than 0.5 μm in diameter and irregularly shaped. A papilla is visible at the distal end of the sporangia.

In *Benua kellermanii* (Swingle ex Sacc.) Constant. (Constantinescu 1998), sporangiophores are unbranched. The ultimate branchlets are regularly aggregated (cephaloid) and reduced (Fig. 2C). The structures remaining on the sporangiophores appear tubular, an annulus is not present and no covering wall can be observed. The pedicels are usually conical (Fig. 2D). A 4-5 μm diameter area of aggregated protuberances is present around the pedicel. Protuberances are large, with up to 1 μm in diameter and irregularly shaped. A papilla is present at the distal end of the sporangia, but hardly visible in SEM.

In *Bremia lactucae* Regel (Regel 1843), sporangiophores are usually branched dichotomously, especially towards the ultimate branchlets, but irregular branching may also occur. A slight broadening towards the ramification can be observed. The ultimate branchlets are mostly regularly aggregated, although irregular aggregation is not uncommon, in groups of (3)-4-5-(6-7). In other species of *Bremia*, the ultimate branchlets may be aggregated in groups of (4)-5-6-(7). The ultimate branchlets are straight, tubular, covered with a caving in wall and mostly with a distinct annulus at their distal end (Fig. 2E). The pedicels are mostly tubular (Fig. 2F). An area of aggregated protuberances is present around the pedicel, with 2-5 μm in diameter. Protuberances are usually

smaller than 0.5 μm and irregularly shaped. A papilla is not visible in SEM in the vast majority of sporangia.

Sporangiophores in *Graminivora graminicola* (Naumov) Thines & Göker (Thines et al. 2006) are branched dichotomously and do not exhibit a broadening towards the ramification. The ultimate branchlets are agglomerated in groups of (2-3)-4-(5-6). The ultimate branchlets are straight, tubular and do not exhibit an annulus at their apex (Fig. 2G). The pedicels are variously shaped, ranging from flat to tubular pedicels. No area of aggregated protuberances around the pedicel is commonly present. Nevertheless, if present, it is usually about 1.5-2 μm . Protuberances are irregularly shaped and usually smaller than 0.5 μm . A papilla is clearly visible in SEM.

Hyaloperonospora parasitica (Pers.) Constant. (Constantinescu & Fatehi 2002) does not exhibit a broadening of the sporangiophores towards the ramifications (Fig. 2I). Branching of the sporangiophores is usually dichotomous, especially towards the ultimate branchlets, but irregular branching may also occur. The ultimate branchlets are spirally coiled in all species of *Hyaloperonospora* examined, but may vary widely in length. They are usually tubular or longish conical and truncate at the apical end; a distinct annulus is not present, although a slight broadening can be observed in some ultimate branchlets. The pedicels are variously shaped, mostly flat or flat conical (Fig. 2J), but irregular tubular pedicels can also be observed. The area of aggregated protuberances around the pedicel is 2-4 μm in diameter. Protuberances consist of rounded, flattened warts, which are mostly fused into irregular structures of about 0.5 μm . A papilla is not present.

In *Paraperonospora leptosperma* (de Bary) Constant. (Constantinescu 1989), sporangiophores are broadening widely towards the ramification, branching is dichotomous to pseudotrictotomous. Ultimate branchlets are straight, longish conical to tubular, with a distinct annulus at the apex (Fig. 2K). Pedicels are conical, with a caving in wall at the proximal end. An area of aggregated protuberances around the pedicel is usually hardly present and less than 3 μm in diameter. Protuberances are mostly very small and less in 0.2 μm in diameter. A papilla is not visible in SEM.

In *Perofascia lepidii* (McAlpine) Constant. (Constantinescu & Fatehi 2002), a broadening of the sporangiophores towards the ramifications can not be observed. Sporangiophores are usually dichotomously branched in the apical region, but pseudotrictotomous branching also occurs. Ultimate branchlets are curved to spirally coiled (Fig. 2M), longish conical, truncate and do not exhibit a distinct annulus at the apex. Pedicels are flat to conical (Fig. 2N). An area of aggregated protuberances around the pedicel is missing or small, with usually less than 2 μm in diameter. Protuberances are mostly smaller than 0.2 μm . A papilla is not present at the apical end of the sporangia.

Peronospora rumicis Corda (Corda 1837) is the type species of the largest genus of the *Peronosporaceae* (de Bary 1863, Constantinescu 1991). In many respects it can stand exemplary for the genus, although some ultrastructural features, especially regarding ornamentation and ultimate branchlets morphology show a high degree of dissimilarity in some species groups compared to each other (data not shown). In *Peronospora rumicis*, sporangiophores do not broaden towards the ramification. Branching is usually dichotomous, but irregular branching may also occur, especially in the first ramifications. Ultimate branchlets are often straight in *Peronospora rumicis*, although curved ultimate branchlets may also occur. For the bulk of *Peronospora* species, curved ultimate branchlets are characteristic (Fig. 1G). In *Peronospora rumicis*, ultimate branchlets are truncate, conical and do not exhibit a distinct annulus. In the majority of *Peronospora* species examined ultimate branchlets exhibited more or less acute tips. Ultimate branchlets shape varies from short conical to conical-tubular. Pedicels are mostly not present in *Peronospora rumicis*. In other species of the genus, conical pedicels can be observed. The area of aggregated protuberances around the pedicel is usually diffuse and large, up to 6 μm in diameter, but might also be hardly visible. Protuberances are variously shaped, often rounded and sometimes with a slight depression in the middle in *Peronospora rumicis*. Protuberances are often small, with less than 0.5 μm in diameter. In other species of *Peronospora*, other modes of ornamentation may occur, ranging from rounded warts in *Peronospora sparsa* Berk. and *Peronospora destructor* (Berk.) Fr. to very small irregular shaped protuberances in *Peronospora farinosa* (Fr.) Fr. (data not shown). A papilla is not present at the apical end of the sporangia.

In *Plasmopara nivea* (Unger) J. Schröt. (Schröter 1886), sporangiophores do not broaden towards the ramifications; branching is usually pseudotridentate to tridentate, especially towards the ultimate branchlets (Fig. 2Q). Ultimate branchlets are mostly straight, truncate with a caving in covering wall at the apex, longish conical to tubular in *Plasmopara nivea* and mostly tubular in many other species, including *Plasmopara pusilla* (de Bary) J. Schröt. and *Plasmopara viticola* (Berk. & M.A. Curtis) Berl. & De Toni (data not shown). Ultimate branchlets exhibit a distinct annulus in the type species and the vast majority of other *Plasmopara* species examined. Pedicels are conical to tubular in *Plasmopara nivea* (Fig. 2R) and in most other species of the genus. An area of aggregated protuberances around the pedicel is present in all species of the genus examined. In *Plasmopara nivea* it ranges from 3–5 μm in diameter. Protuberances are variously shaped, usually very irregular and about 0.5 μm or less in diameter. A papilla is visible in SEM at the apical end of the sporangia in most species of the genus.

In *Plasmoverna pygmaea* (J. Schröt.) Constant. et al. (Constantinescu et al. 2005), sporangiophores are often slightly broadening towards the ramifications, branching is irregular to trichotomous for the first ramification and irregular for the ultimate branchlets, which are often aggregated in variable number. Ultimate branchlets are broad tubular, often without covering wall at the apex or with a wall deeply caving in, and mostly exhibiting a distinct annulus (Fig. 2S). In some hosts other than *Anemone nemorosa* L., ultimate branchlets may be tubular with a bowl-shaped covering wall (data not shown). Pedicels are flat or even cave in (Fig. 2T). An area of aggregated protuberances around the pedicel is present in few, but missing in the vast majority of sporangia, in contrast to *Plasmopara* species. Protuberances are variously shaped and usually very small, with less than 0.2 μm . A papilla is clearly visible in SEM.

Sporangiophores of *Protobremia sphaerosperma* (Sävil.) Voglmayr et al. (Voglmayr et al. 2004) exhibit a slight broadening of the sporangiophore trunk towards the ramifications. Ramification is pseudotrictotomous to irregular, the ultimate branchlets often becoming aggregated in variable number. Ultimate branchlets are longish conical to straight, truncate at the apex and exhibiting a distinct annulus and a caving in covering wall (Fig. 2U). Pedicels are conical to tubular. An area of aggregated protuberances around the pedicel is clearly visible and mostly 3–5 μm in diameter. Protuberances are variously shaped and often very small, with less than 0.2 μm in diameter. A papilla is hardly visible in SEM at the apical end of a minority of the sporangia.

Pseudoperonospora cubensis (Berk. & Curtis) Rostovzev (Rostovzev 1903) does not exhibit a broadening of the sporangiophores towards the ramifications. Branching is mostly dichotomous (Fig. 2W), but also pseudotrictotomous branching may occur in some samples of this variable species. Ultimate branchlets are usually conical to conical tubular and truncate at the apical end, not exhibiting a distinct annulus. However, in some samples, an annulus might be present. Pedicels are variously shaped, ranging from flat to tubular. An area of aggregated protuberances around the pedicel is present in most sporangia, which is usually less elevated over the mean sporangial surface than the protuberances and varies in diameter, mostly ranging from 2–4 μm . Protuberances are mostly rounded warts (Fig. 2X) with less than 0.5 μm in diameter. A papilla is mostly visible in SEM.

Figure 2 (facing page). Main Ultrastructural characteristics of the genera of the *Peronosporaceae*. First and third column, ultimate branchlets; second and forth column, proximal end of the sporangia. A and B, *Basidiophora entosporea* (1); C and D, *Benua kellermanii* (2); E and F, *Bremia lactucae* (3); G and H, *Graminivora graminicola* (4); I and J, *Hyaloperonospora parasitica* (5); K and L, *Paraperonospora leptosperma* (7); M and N, *Perofascia lepidii* (9); O and P, *Peronospora rumicis* (13); Q and R, *Plasmopara nivea* (17); S and T, *Plasmoverna pygmaea* (23); U and V, *Protobremia sphaerosperma* (25); W and X, *Pseudoperonospora cubensis* (26).

Bar = 5 μm in all pictures. Numbers in brackets refer to Fig. # in Table 1 (collection details).

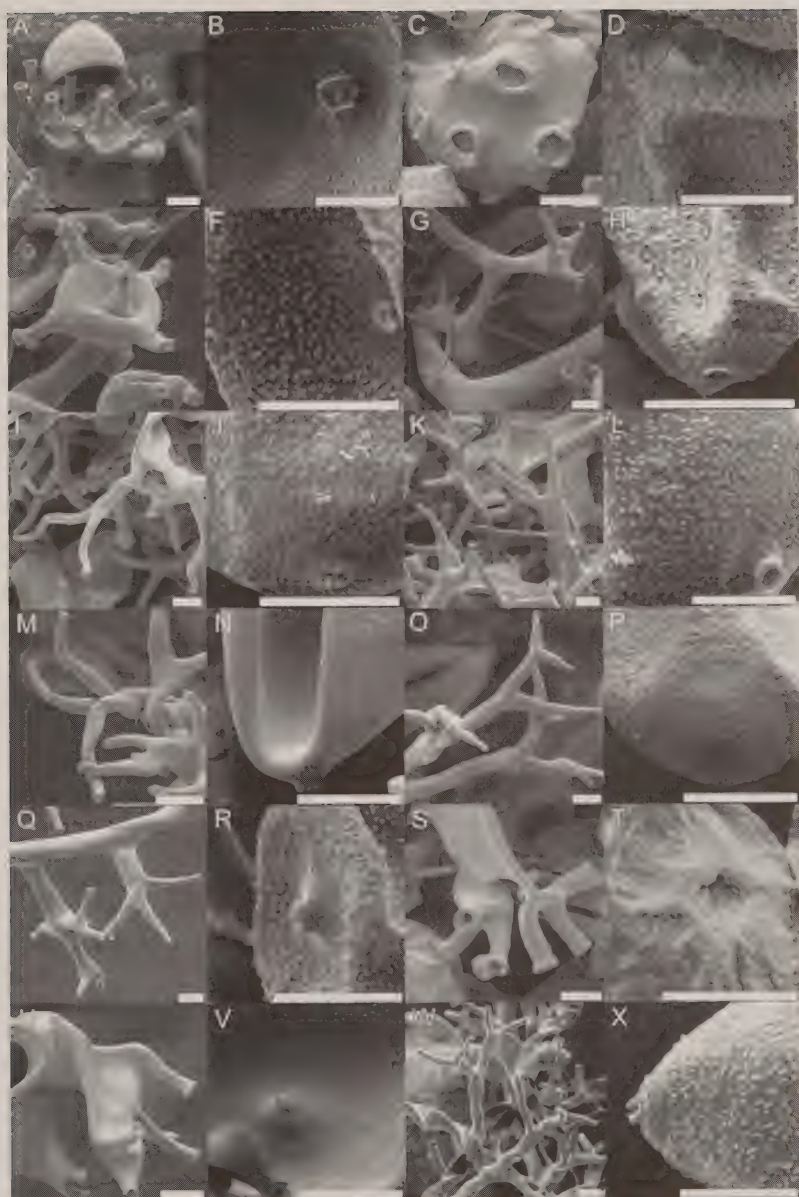


Table 2. Morphological and ultrastructural characteristics of the downy mildews.

Characteristics		B a s	B e n	B r e	G r a	H y a	P a r	P f a	P e r	P l a	P l v	P r o	P s p	V i e	v a r.
sporangio- phores	distal broadening	+	-	+	-	-	+	-	-	-	+	+	-	-	lm
	no distal broadening	-	-	-	+	+	-	+	+	+	-	-	+	+	lm
ultimate branchlets	no annulus	-	-	-	+	+	-	+	+	-	-	-	+	n	lm
	with annulus	+	+	+	-	-	+	-	-	+	+	+	-	n	lm
	conical	-	-	-	-	-	-	-	+	-	-	-	+	-	lm
	tubular	+	+	+	+	+	+	+	-	+	+	+	-	+	lm
	acute	-	-	-	-	-	-	-	+	-	-	-	-	-	lm
	truncate	+	+	+	+	+	+	+	-	+	+	+	+	+	lm
	flat covering wall	-	-	-	+	+	-	+	+	-	-	-	+	n	lm
	Missing or caving in covering wall	+	+	+	-	-	+	-	-	+	+	+	-	n	lm
	mostly dichotomous	-	-	-	-	+	-	+	+	-	-	-	+	+	lm
	pseudo-trichotom	-	-	-	-	-	+	-	-	+	-	-	-	-	lm
	irregular / aggregated	-	-	+	+	-	-	-	-	-	+	+	-	-	lm
	cephaloid	+	+	-	-	-	-	-	-	-	-	-	-	-	l
	spiral	-	-	-	-	+	-	+	-	-	-	-	-	-	m
	straight	+	+	+	+	-	+	-	-	+	+	+	+	+	m
	curved	-	-	-	-	+	-	+	+	-	-	-	-	-	m
sporangia	coloured	-	-	-	-	-	-	-	+	-	-	-	+	-	lm
	white	+	+	+	+	+	+	+	-	+	+	+	-	+	lm
	with papilla	+	+	-	+	-	-	-	-	+	+	-	+	+	l
	no papilla	-	-	+	-	+	+	+	+	-	-	+	-	-	l
haustoria	branched	-	-	-	-	-	-	-	+	-	-	-	+	-	lm
	unbranched	+	+	+	+	+	+	+	-	+	+	+	-	+	lm
	hyphal	-	-	-	+	-	-	+	+	-	-	-	-	+	lm
	lobate	-	-	-	-	+	-	-	-	-	-	-	-	-	lm
	vesicular	+	+	+	-	-	+	-	-	+	+	+	+	-	lm
pedicels	flat	-	-	-	+	-	-	-	+	-	+	-	-	n	h
	conical	-	+	-	-	+	+	+	-	+	-	-	+	n	mh
	tubular	+	-	+	-	-	-	-	-	-	-	+	-	n	h
area of aggr. prot.	distinct	+	+	+	-	+	+	+	+	+	-	+	+	n	m
	indistinct	-	-	-	+	-	-	-	-	-	+	-	-	n	m

Table 2, concluded

Characteristics		B a s	B e n	B r e	G r a	H y a	P a r	P f a	P e r	P l a	P l v	P r o	P s p	V i e	v a r.
ornamen- tation	rounded	-	-	-	-	+	+	-	+	-	-	-	+	n	m
	irregular	+	+	+	+	-	-	+	-	+	+	+	-	n	m
	fine	+	-	-	-	-	+	+	-	-	-	+	-	n	h
	rough	-	+	+	+	+	-	-	+	+	+	-	+	n	h

Abbreviations in Table 2: area of agg. prot. = area of aggregated protuberances around the pedicel.

Bas = *Basidiophora*, *Ben* = *Benua*, *Br* = *Bremia*, *Gra* = *Graminivora*, *Hya* = *Hyaloperonospora*, *Par* = *Paraperonospora*, *Pfa* = *Perofascia*, *Per* = *Peronospora*, *Pla* = *Plasmopara*, *Plv* = *Plasmoverna*, *Pro* = *Protobremia*, *Psp* = *Pseudoperonospora*, *Vie* = *Viennotia*. + = mostly present, - = mostly absent, n = data not available.

Last column indicates the variability (var.) of the characters. h = high variability, about 40% of the samples show variable characteristics; m = medium variability, less than 20% exhibit diverging characteristics; l = low variability, less than 10% variation. Intermediate values are given by combining the letters.

Overview of ultrastructural and morphological characters of the downy mildews

The morphological and ultrastructural characteristics of the downy mildew genera are summarised in Table 2. For the diverse and species-rich genera *Hyaloperonospora*, *Peronospora* and *Plasmopara*, modal values are given which do not necessarily represent all of the species currently classified in the corresponding genus.

A phylogenetic tree computed from a distance matrix based on Table 2 is given in Figure 3. Notably, the genera parasitic to *Poaceae* as well as the genera parasitic to *Brassicaceae* are grouped together, respectively. Also the morphologically very different genera *Basidiophora*, *Benua*, *Bremia*, *Paraperonospora*, *Plasmopara*, *Plasmoverna* and *Protobremia* are grouped together due to similarities in haustorial morphology and ultrastructural characteristics. Furthermore, the downy mildews with coloured sporangia are grouped together. Interestingly, the five genera exclusively parasitic to *Asteraceae* (*Basidiophora*, *Benua*, *Bremia*, *Paraperonospora*, *Protobremia*) form a single group together with *Plasmoverna* (parasitic to *Ranunculaceae*).

Discussion

Until first molecular phylogenetic reconstructions of the downy mildews became available (Riethmüller et al. 2002, Constantinescu & Fatehi 2002), the main reasons for separating the *Peronosporaceae* into several genera where morphological peculiarities in sporangiophore anatomy and biological

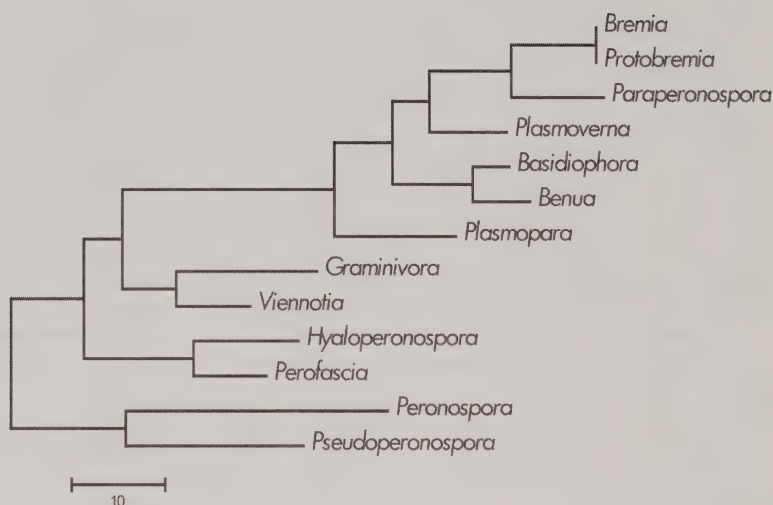


Figure 3. Phylogenetic tree computed from a reduced Matrix of Table 2, covering only characteristics of which variation is usually low. Neighbor-joining analysis (Saitou & Nei 1987) was performed on a distance matrix calculated with the formula of Jaccard (1908). Bar = 10% divergence.

differences, e.g. germination of the mitotically formed sporangia. However, the delimitation of genera by means of these features has often proven to result in polyphyletic assemblages, as revealed in molecular phylogenies for *Plasmopara* (Riethmüller et al. 2002, Göker et al. 2003, Voglmayr et al. 2004, Constantinescu et al. 2005) and *Bremia* (Thines et al. 2006). Also the monophyly of *Peronospora*, with respect to *Pseudoperonospora* has been asserted (Riethmüller et al. 2002, Voglmayr 2003, Thines et al. 2006).

Haustoria

Haustorial shape has been systematically investigated in the *Peronosporaceae* by Fraymouth (1956) and her findings have been confirmed by the recent investigations of Göker et al. (2003) and Voglmayr et al. (2004). Voglmayr et al. (2004) point out that haustorial shape is well in line with molecular phylogenetic reconstructions. In Göker et al. (2003) and Voglmayr et al. (2004) it has been shown that the group of downy mildews with pyriform haustoria (DMPH) form a monophyletic clade. This view is also confirmed by the presence of large, 180 bp repetitions found in the ITS2 in these species, which were first reported for *Plasmopara halstedii* (Farl.) Berl. & De Toni by Thines et al. (2005) and later found to be present in all DMPH (Thines, unpublished results). Likewise, the species with lobate haustoria all belong to the genus *Hyaloperonospora*. The

species with hyphal haustoria do not form a monophyletic group in molecular phylogenetic reconstructions, suggesting the ancestral state for the character “haustoria” is hyphal.

Sporangiophores

The molecular phylogenies of Riethmüller et al. (2002), Göker et al. (2003) and Voglmayr et al. (2004) revealed that the branching type of the sporangiophores is not a character useful for forming taxonomic groups, and led to confusing classifications, especially of the species now placed in *Paraperonospora*. For example, sympodial-looking branching is found in several unrelated genera, such as *Bremia*, *Hyaloperonospora* and *Peronospora*. Furthermore, irregular monopodial branching resulting in sporangiophores with sympodial appearance can also be found in these genera. Also the mode of branching of the ultimate branchlets is not unequivocally useful for phylogenetic considerations, as is revealed by Voglmayr et al. (2004) and Thines et al. (2006). The morphology of the internodal parts of the sporangiophores, however, might be useful for systematic studies. The broadening of the sporangiophores towards the ramifications, which is one of the characteristics of *Paraperonospora* in comparison with *Peronospora* (Constantinescu 1989) can also be found in *Protobremia* and *Bremia*, as well as in the rarely branching genera *Plasmoverna* and *Basidiophora*. In recent molecular phylogenies, these genera form a monophyletic clade (Göker et al. 2003, Voglmayr et al. 2004, Thines et al. 2006).

Ultimate branchlets

The ultimate branchlets in the *Peronosporaceae* show several characteristics which might be used for systematic studies, especially in SEM. The shape of the ultimate branchlets varies from conical to tubular. However, it is sometimes difficult to draw clear lines between these two states, especially if the ultimate branchlets are by the factor of ten or more longer than wide. In these cases, ultimate branchlets have been regarded as tubular, if they are slightly or not tapering to the apical end. Similarly, the shape of the tip of the ultimate branchlets can be used as a differentiating character. However, also in this case it is often not easy to draw the line in between acute and truncate ultimate branchlets. Also in *Peronospora*, where most species have acute ultimate branchlets, some species (including the type species, *Peronospora rumicis*) show truncate ultimate branchlets. Therefore it is uncertain, whether this character is valuable for systematic classification. In the DMPH the wall covering the truncate ultimate branchlets often bulges in (e.g. in *Plasmopara* and *Bremia*) or is even deeply retreated or sometimes missing (Constantinescu et al. 2005), as in *Plasmoverna*. In *Benua* it is not present and the sporangiophores are sealed by a wall below the reduced ultimate branchlets.

A character easily accessible in SEM is the presence or absence of an annulus or a broadening of the ultimate branchlets towards their distal end. This annulus is present in all genera with pyriform haustoria and clearly visible in the genera *Bremia*, *Protobremia*, *Paraperonospora*, *Basidiophora* and *Plasmoverna*. In *Plasmopara* species it is also present, but in some species (e.g. *Plasmopara pusilla*) not as clearly visible as in the other genera. Because of the high degree of reduction of the ultimate branchlets in *Benua*, this character can not be unequivocally accessed there, but the broadening of the remains of the ultimate branchlets towards their distal ends may be seen as a homology to the annulus in the other DMPH. In the other genera of the *Peronosporaceae*, a distinct annulus is not present. Only in *Pseudoperonospora*, and sometimes in *Hyaloperonospora*, ultimate branchlets may show an indistinct annulus in some cases. In the genera *Hyaloperonospora*, *Perofascia*, and *Graminivora*, the ultimate branchlets are truncate and conical-tubular to tubular and in most cases do not exhibit an annulus. Because of the presence of an often indistinct annulus in *Pseudoperonospora* and in some samples of *Hyaloperonospora*, it could be concluded, that the character “annulus” is a plesiomorphy retained in the DMPH.

Pedicels

The use of pedicels at the proximal end of the sporangia for the characterisation of downy mildew genera or even species is not possible. Especially in the genera *Plasmopara* and *Hyaloperonospora*, this character may differ widely, even within one collection. Even more as in case of the sporangial shape, it is hardly possible to draw a clear line between conical and tubular pedicels. However, as in case of *Plasmoverna* in comparison with *Plasmopara*, pedicels may provide some information useful for classification, if combined with other characteristics.

Sporangial germination / dehiscence apparatus and papilla

Germination of the sporangia or the presence or absence of a dehiscence apparatus has often been used as an argument to integrate new taxa into existing genera (e.g. *Plasmopara oplismeni* Vienn.-Bourg., now classified as *Viennotia oplismeni* (Vienn.-Bourg.) Göker et al.) or to segregate genera, in combination with other characteristics; for example *Peronosclerospora* from *Sclerospora* (Shirai & Hara 1927) and *Pseudoperonospora* from *Peronospora* (Rostovtzev 1903), as well as *Rhysotheca* from *Plasmopara* (Wilson 1914). However, the mode of germination may be temperature and humidity dependent, which has been described for *Phytophthora* by Blackwell & Waterhouse (1930). In addition, sporangial germination is often only badly studied and not accessible in herbarised material. For the *Peronospora sparsa* agg., parasitic to *Rosaceae*, zoospore production has been reported (Skalický 1966 and references therein),

possibly pointing to a common evolutionary background of *Peronospora sparsa* and *Pseudoperonospora* species, which are, except for the type species, *Pseudoperonospora cubensis*, parasitic to *Rosales* sensu Angiosperm Phylogeny Group (Bremer et al. 1998, Bremer et al. 2003).

The situation is even more complicated when taking into account structures reminiscent of a dehiscence apparatus, as can be observed in some species of *Paraperonospora* (Constantinescu 1989). In addition, it has been shown by the molecular phylogenies mentioned above, that the character “presence or absence of a papilla” is spread rather randomly in the *Peronosporaceae*. In SEM, the papilla is clearly visible in some genera (e.g. *Plasmopara*, *Graminivora*) but can hardly be seen in others (e.g. *Benua*). The genera *Bremia* and *Protobremia* both reveal a papilla in LM, but this characteristic is not visible in the vast majority of sporangia in SEM. Furthermore, it can not be observed in any collection from these genera. Therefore, it is not feasible to use SEM for investigating this character. The character “presence or absence of a papilla” can be used well for classification, although it is hardly of taxonomic relevance in groups above the generic level. For detailed discussion see Constantinescu (2000).

Sporangial colour

In the downy mildews, sporangia are coloured only in the genera *Pseudoperonospora* and *Peronospora*. In most molecular phylogenies, these two genera are mono- or paraphyletic, indicating that the colouration of the sporangia is a synapomorphy for the species exhibiting this character. However, sporangial colour is not or only hardly present in some species of *Peronospora* parasitic to *Caryophyllaceae* (Gäumann 1923), so sporangial colour alone is not sufficient to characterise species belonging to this group.

Surface ornamentation

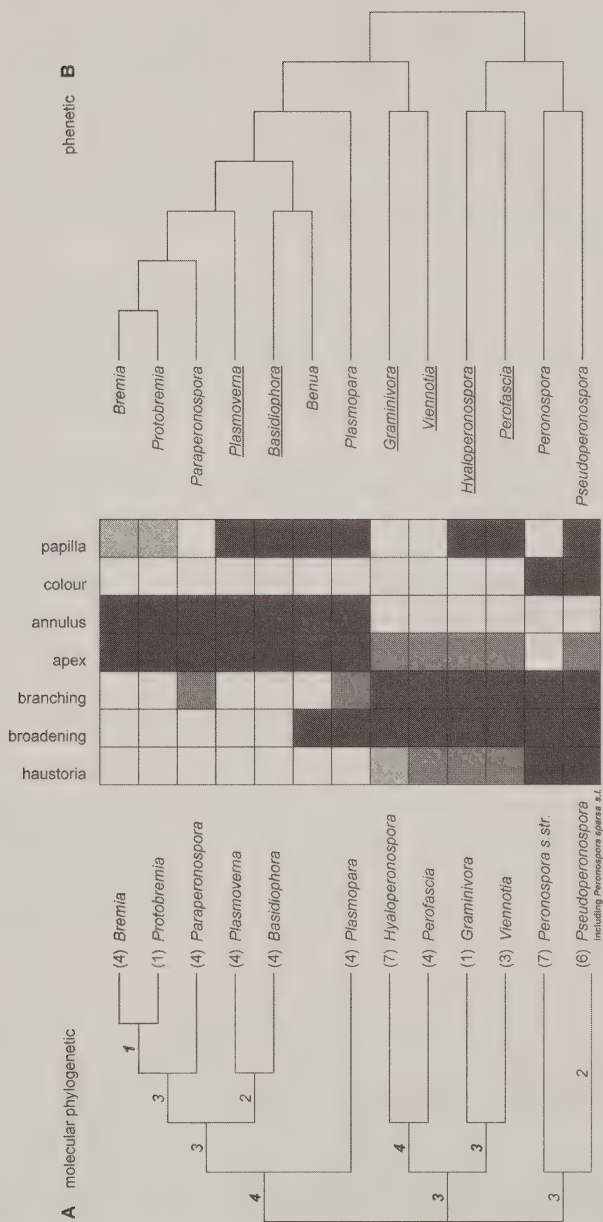
Sporangia of all downy mildews show ornamentation in SEM, although they may appear smooth in LM, as stated for *Hyaloperonospora* by Constantinescu & Fatehi (2002). Ornamentation ranges from very small warts as in *Paraperonospora* to large irregular protuberances in *Benua*. However, the density and diameter of the protuberances may vary greatly between collections of the same species or even within one collection. Therefore, only the shape of the protuberances might be useful for classification in some cases, e.g. the large, rounded warts found in *Pseudoperonospora*. Whether the shape of the protuberances can also be used for the delimitation of other genera is questionable, although the flat, irregular but rounded protuberances in *Hyaloperonospora* are also almost exclusively found in this genus. The area of aggregated protuberances around the pedicel, which may be missing in *Graminivora* and *Plasmoverna* may vary greatly in dimension, even within the same collection. Therefore, this character

should only carefully be used for systematic studies in combination with other characteristics. However, the way the yard is expressed in some genera, e.g. the hardly elevated yard in *Pseudoperonospora*, might constitute a distinct character for this group of species.

Conclusions

Due to lack of resolution and often conflicting evidence, especially due to “rogue taxa” with a long lasting independent evolutionary history, such as *Basidiophora*, molecular phylogenies are often unable to conclude on the correct position of the species examined with the sequence data available (Thines et al. 2006). Ultrastructural features, which have already been successfully applied on the *Albuginaceae* (Thines & Spring 2005, Voglmayr & Riethmüller 2006), have some potential for giving information useful for the characterisation of monophyletic groups, if carefully investigated in the context of molecular phylogenies (Fig. 4). Although some of the genera are placed slightly different in the phenetic analysis in comparison to molecular phylogenetic reconstructions (underlined in Fig. 4), the phenetic analysis is mainly in concordance with the molecular phylogenies.

Figure 4 (facing page). Comparison of the phenetic tree presented in this study with a hypothetical molecular phylogenetic tree combined from the molecular phylogenetic reconstructions of Riethmüller et al. (2002), Constantinescu & Fatehi (2002), Göker et al. (2003), Choi et al. (2003), Voglmayr (2003), Voglmayr et al. (2004), Choi et al. (2005) and Thines et al. (2006). Clades of the hypothetical molecular phylogenetic tree (left) are supported by the majority of the molecular phylogenetic reconstructions. Italic numbers above the branches indicate the number of molecular phylogenies in favour of the corresponding branch. If these numbers are bold italic, no conflicting molecular phylogenetic evidence exists. Italic numbers in brackets before the genus names indicate the number of molecular phylogenies which include the corresponding taxon. Phenetic tree (right) showing a slightly different topology compared to the molecular phylogenetic tree. Genera which are placed differently in the phenetic tree are underlined. Matrix in between the trees shows the main characters useful for systematic studies and characters hitherto commonly used. Same greyscales indicate same expression of a certain character. **Papilla:** dark grey, papilla visible in SEM; light grey, papilla visible only in a minority of sporangia in SEM, but visible in light microscopy (LM); white, no papilla present (in *Paraperonospora*, some atavistic forms of a papilla can sometimes be seen in LM). **Colour:** dark grey, sporangia pigmented; white, sporangia colourless. **Annulus:** dark grey, annulus present; light grey, annulus absent. **Apex:** dark grey, ultimate branchlets truncate, with a caving in wall; light grey, truncate, wall sealing the ultimate branchlets, if at all, only caving in at the midpoint; white, ultimate branchlets mostly acute. **Branching:** dark grey, branching of the outer branches mostly dichotomous; light grey, branching of the ultimate branches mostly pseudotrichotomous; white, ultimate branchlets regular or irregular aggregated. **Broadening:** dark grey, sporangiophores not broadening towards the ramifications; white, broadening of the sporangiophores towards the ramifications present, at least for the last two ramifications. **Haustoria:** dark grey, haustoria branched; light grey, haustoria hyphal; lighter grey, haustoria lobate; white, haustoria globose to pyriform.



For the genera *Basidiophora*, *Benua*, *Bremia*, *Paraperonospora*, *Plasmopara*, *Plasmoverna* and *Protobremia*, vesicular to pyriform haustoria are characteristic and most likely represent a synapomorphy for these. Likewise, the presence of an annulus or broadening of the ultimate branchlets towards their distal end is characteristic for these genera. *Plasmopara*, which is also placed basal in the molecular phylogenetic reconstructions of Göker et al. (2003), Voglmayr et al. (2004) and Thines et al. (2006), is the only one of the DMPH which does not regularly show a broadening of the sporangioophores towards the ramifications.

Perofascia and *Hyaloperonospora* are grouped together in all molecular phylogenetic reconstructions computed so far. This sister-group relationship is also apparent from phenetic comparisons. Especially the truncate and curved to spiral ultimate branchlets tie these genera together. It is also notable that both genera are (with a few exceptions in *Hyaloperonospora*) parasitic to *Brassicaceae*.

Hyaloperonospora and *Perofascia* are grouped together with the *Poaceae* infecting genera of the *Peronosporaceae* in some molecular phylogenetic reconstructions (Göker et al. 2003). Possibly, the truncate ultimate branchlets without distinct annulus, together with the colourless sporangia can be regarded as a combination of characters tying this group together. In unweighted phenetic analysis, this placement is not supported, however (Fig. 3). The genera *Viennotia* and *Graminivora* are, in spite of some differences in the morphology of the ultimate branchlets and terminal branches torn together by the presence of heavily coiled haustoria and a distinct papilla (Göker et al. 2003, Thines et al. 2006). The genera with uncoloured sporangia and with coloured sporangia each form monophyletic groups in the phenetic analysis presented (Fig. 4).

There is conflicting evidence for a monophyly of the *Peronosporaceae* with regard to *Phytophthora* s.str. and evidence that the *Sclerosporaceae* are almost certainly nested into the *Peronosporaceae* (Riethmüller et al. 2002, Göker et al. 2004, Thines et al. 2006). However, to clarify this situation, a thorough ultrastructural investigation of the *Sclerosporaceae* and *Phytophthora* de Bary has to be conducted.

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The mycobiota of Itapuã Park, Rio Grande do Sul, Brazil. I. Species of *Strophariaceae* (Agaricales)

PAULA SANTOS DA SILVA, VAGNER GULARTE CORTEZ
& ROSA MARA BORGES DA SILVEIRA

pulisant@yahoo.com.br cortezvg@yahoo.com.br rosa.silveira@ufrgs.br
Universidade Federal do Rio Grande do Sul, Departamento de Botânica
Av. Bento Gonçalves, 9500, CEP: 91501-970, Porto Alegre, RS, Brazil

Abstract—In a fungal survey of the Itapuã Park, in south Brazil, the agaric family *Strophariaceae* was studied. *Hypholoma aurantiacum*, *H. ericaeum*, *Psilocybe caeruleoannulata*, *P. coprophila*, *P. cubensis*, *P. muscorum*, *P. wrightii*, *Stropharia alcis*, and *S. coronilla* are reported. *Psilocybe muscorum* is reported for the first time in Brazil, while *S. alcis* is a new record in South America.

Key words—macromycete inventory, Basidiomycota, subtropical vegetation

Introduction

Macromycete inventory was carried out in the Itapuã State Park, a protected area in the municipality of Viamão, Rio Grande do Sul, south Brazil. This investigation aims to provide a list of the macrofungi (Homobasidiomycetes) from the area. In this first contribution are presented the results of the agarics belonging to the family *Strophariaceae* Singer & A.H. Sm.

This group includes dark-spored mushrooms occurring in several types of substrate, including litter, decayed wood, dung and mosses (Singer 1986, Watling & Gregory 1987). Previous studies reporting members of *Strophariaceae* from Rio Grande do Sul State were published by Rick (1907, 1939, 1961), Singer (1953), Cortez & Coelho (2004), Guzmán & Cortez (2004, 2005) and Sobestansky (2005).

Materials and methods

Description of the study area – The Itapuã State Park (30°20' - 30°27' S and 50°50' - 51°05' W) is situated in the municipality of Viamão, state of Rio Grande do Sul, Brazil (Fig. 1). Its area is about 53.33 km², and the eastern limit is Patos Lagoon (“Laguna dos Patos”), while the western limit is the Guaíba Lake (“Lago Guaíba”). According to Rambo (1956), this area is situated in the

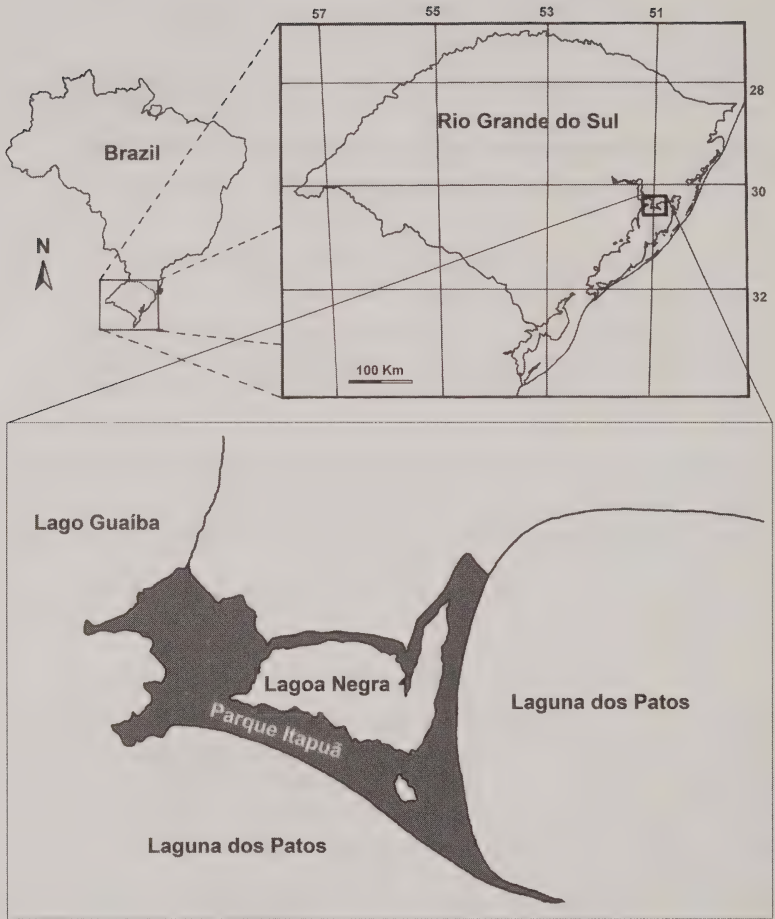


Figure 1. Location of Itapuã Park, in Rio Grande do Sul State, south Brazil.

physiographic region of the Southeast Highlands, which includes the southern montane region of the State. Among the landscape of the Park, there are eight beaches, the Negra Lagoon (“Lagoa Negra”) and several ponds, marshes and granitic hills (Irgang 2003).

The relief is formed by granite hills of Crystalline Shield (“Escudo Cristalino”); rocks are represented by sandy and clay materials, deposited during the Quaternary Age. The subtropical climate is of the Cfa type, with annual mean temperature about 17°C, and precipitation between 1100 and

1300 mm, with well distributed rainfall throughout the year (Irgang 2003). The vegetation is mainly composed of forests and meadows, characterized by a great floristic diversity, and is included in the Atlantic Rain Forest domain. The forest vegetation comprises characteristic species such as *Ficus organensis* Miq., *Enterolobium contortisiliquum* (Vell.) Morong, *Luehea divaricata* Mart., and *Lithraea brasiliensis* Marchand. The less common forests are the sand dune forests ("restinga") and the peat forests ("mata paludosa"), with an irregular canopy and typical species such as *Citharexylum myrianthum* Cham., *Cecropia pachystachya* Trécul, *Erythrina crista-galli* L., and *Syagrus romanzoffiana* (Cham.) Glassman. The riparian forests are formed especially by *Pouteria gardneriana* (A. DC.) Radlk., and *Terminalia australis* Cambess. (Brack et al. 1998).

Methods – The specimens were collected during October 2003 to September 2005. Microscopic observations were made after drying, with thin sections mounted in 5% KOH and 1% Congo Red solutions (Largent et al. 1986). Specimens are deposited in the herbarium ICN; additional specimens from HCB were also considered.

Results and discussion

1. *Hypholoma aurantiacum* (Cooke) Faus in Moreno & Faus, Bol. Soc. Micol. Castell. 7: 70, 1982.

FIG. 2-6

Pileus 18 mm diam., convex to aplanate, reddish brown, slightly darker in the centre, smooth, subviscid, margin exhibiting velar remnants, like white floccose fugacious scales. **Lamellae** adnexed, gray to light violaceous, with entire and whitish edges. **Stipe** 60 x 6 mm, subcylindrical with a curved base, whitish to pale yellow above, reddish orange at the base, fibrous, hollow, with longitudinal grooves, white rhizomorphs present at the base. **Veil** represented by a vestigial annulus represented by white scales about 15 mm below the pileus.

Basidiospores 10-12 x 6-7 μm , ellipsoid to ovoid in face- and side-view, yellowish brown, thick-walled, with a broad and distinct germ pore at apex and a short basal appendage. **Basidia** (23-) 25-34 x 8-11 (-13) μm , clavate, 4-spored, hyaline, thin-walled. **Chrysocystidia** 30-42 x 7-11.5 μm , fusoid, sometimes with mucronate apex, with yellowish amorphous contents. **Cheilocystidia** (22-) 25-35 (-45) x 5-7 μm , cylindrical to ventricose, hyaline. **Hymenophoral trama** regular to subregular, with hyaline hyphae, 7.5-12 μm wide. **Pileipellis** as an ixocutis, with hyaline, filamentous hyphae 3.5-6 μm wide. **Hypodermium** distinctly subcellular, formed by subglobose hyphae with yellowish incrustated walls. **Caulocystidia** 33-55 x 3.5-8 μm , cylindrical to ventricose, hyaline, similar to cheilocystidia.

STUDIED COLLECTION – BRAZIL. Rio Grande do Sul State, Viamão, Itapuã Park, 10.09.2005, *M. Rother* 082/05 (ICN 139.172); growing on soil, in subtropical vegetation, near to bamboos.

Remarks: This species is mentioned in European literature (e.g. Orton 1960, Watling & Gregory 1987) as *Stropharia* because of the fibrillose annulus on stipe, but the cellular hypodermium and the absence of acanthocytes on its rhizomorphs exclude it from that genus. The placement in *Hypholoma*/*Naematoloma* was discussed by Guzmán (1975), Moreno & Faus (1982), and Singer (1986), among others. Rick (1907) made the first record of this species from Rio Grande do Sul State as *Stropharia thrausta* (Schulzer ex Kalchbr.) Sacc. It was also recorded from the states of Paraná (de Meijer 2001) and Rio Grande do Sul (Sobestiansky 2005), both as *S. aurantiaca*.

2. *Hypholoma ericaeum* (Pers.: Fr.) Kühner, Bull. Soc. Mycol. Fr. 52: 23, 1936.

FIG. 7-11

Pileus 8-27 mm diam., campanulate to convex, umbonate, yellowish brown in the center, becoming lighter toward edges, smooth, subviscid. **Lamellae** adnexed, gray in younger specimens and violaceous in others, with entire and whitish edges. **Stipe** 60-95 x 4 mm, cylindrical to sinuous, yellow to yellowish brown, with some scales on surface and little longitudinal grooves at apex, fibrous, without rhizomorphs. **Veil** poorly developed, not forming annulus neither marginal remnants on pileus margin.

Basidiospores 12-15 x 6.5-9 µm, ovoid in face-view and ellipsoid in side-view, yellowish brown, with a broad germ pore, thick-walled. **Basidia** 22-35 (-40) x 6-10 µm, subclavate, 4-spored, hyaline, thin-walled. **Chrysocystidia** 30-56 (-65) x 7-15 µm, fusoid to lageniform with mucronate apex, with yellowish amorphous contents. **Cheilocystidia** (22-) 25-35 x 3-7 µm, lageniform to subcapitate, hyaline, numerous. **Hymenophoral trama** regular, with hyaline hyphae 7-18 µm wide. **Pileipellis** as an ixocutis, with filamentous and hyaline hyphae 4-8 µm wide. **Hypodermium** composed of filamentous hyphae with incrustated walls. **Caulocystidia** 22-38 x 4-8 µm, lageniform to subcapitate, similar to cheilocystidia.

STUDIED COLLECTIONS – BRAZIL. Rio Grande do Sul State, Viamão, Itapuã Park, 17.08.2004, *P.S. Silva* 093/04 (ICN 139.080), *P.S. Silva* 094/04 (ICN 139.081); 30.04.2005, *P.S. Silva* 122/05 (ICN 139.082); 24.05.1988, *Maria* (HCB 1572 – as *Psilocybe sabulosa* Peck); growing on sandy and moist soil, among grasses and mosses.

Remarks: Noordeloos (1999) considered this species as *Psilocybe ericaea* (Pers.: Fr.) Quél. belonging to section *Psilocyboides* (Singer) Noordel., subsection *Ericaeae* Noordel. In Brazil, *H. ericaeum* was recorded by de Meijer (2001) for the state of Paraná, and by Singer (1953 – as *Naematoloma subumbonatescens* (Murrill) Singer) and Rick (1961 – as *P. ericaea*) from Rio Grande do Sul. It is

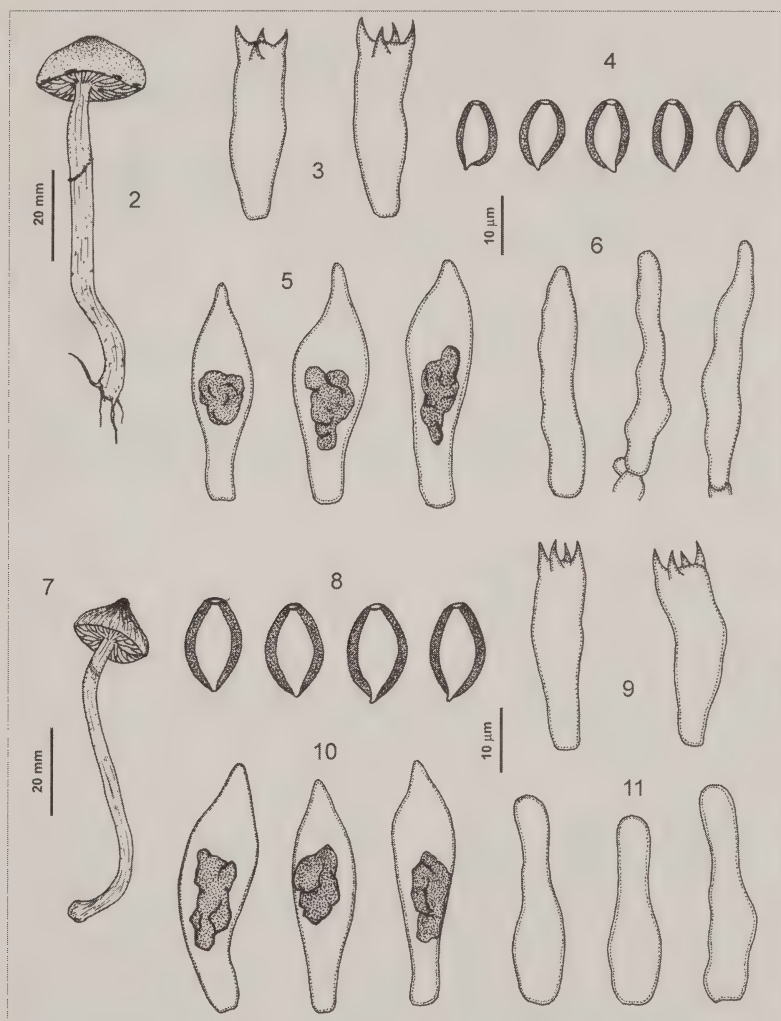


Figure 2-11. 2-6: *Hypholoma aurantiacum*. 2. Basidiome. 3. Basidia. 4. Basidiospores.
 5. Chrysocystidia. 6. Cheilocystidia.
 7-11. *Hypholoma ericaeum*. 7. Basidiome. 8. Basidiospores. 9. Basidia.
 10. Chrysocystidia. 11. Cheilocystidia.

a common species occurring in the area, being frequently collected in humid places.

3. *Psilocybe caeruleoannulata* Singer ex Guzmán, Mycotaxon 7: 235, 1978.

STUDIED COLLECTION – BRAZIL. Rio Grande do Sul State, Viamão, Itapuã Park, 16.04.2005, *P.S. Silva 110/05* (ICN 139.084), growing on soil and litter into the subtropical forest.

Remarks: This species was recently reported from Rio Grande do Sul by Guzmán & Cortez (2004), who considered *P. uruguayensis* Singer ex Guzmán as a synonym. A complete description of this bluing mushroom is found in Guzmán (1983) and Guzmán & Cortez (2004).

4. *Psilocybe coprophila* (Bull.: Fr.) P. Kumm., Führ. Pilzk.: 71, 1871.

STUDIED COLLECTION – BRAZIL. Rio Grande do Sul State, Viamão, Itapuã Park, 19.10.1987, *Batista* (HCB 15.218), on dung.

Remarks: This widespread coprophilous species has not been found in the area after the exclusion of cattle and horses from the area for conservation purposes. A full description of south Brazilian specimens is found in Cortez & Coelho (2004).

5. *Psilocybe cubensis* (Earle) Singer, Sydowia 2: 37, 1948.

STUDIED COLLECTION – BRAZIL. Rio Grande do Sul State, Viamão, Itapuã Park, 05.04.1988, *A.B. Pereira* (HCB 15.236), on cow dung.

Remarks: As the previous species, this hallucinogenic mushroom was found only before the inoculation of the area. With the exclusion of the cattle and horse, coprophilous species has been not found. See descriptions and discussion in Guzmán (1983) and Cortez & Coelho (2004).

6. *Psilocybe muscorum* (P.D. Orton) M. M. Moser, Kleine Kryptogamenflora Ed. 3,

II b/2: 239, 1967.

FIG. 12-16

Pileus 4-10.5 mm diam., convex to hemispheric, becoming applanate or expanded to slightly depressed, dark brown to pale yellowish brown towards the margin, slightly moist, translucent-striate, with a separable pellicle, context thin, membranous, pale brownish. **Lamellae** adnate, subdistant, yellowish brown, edge regular and whitish. **Stipe** 14-27 x 1-2 mm, central, cylindrical, with the base slightly thickened, yellowish brown, turning to whitish in maturity, smooth to pruinose, dry to moist, hollow, fibrous. **Veil** forming a fibrous annular zone.

Basidiospores 7-9 x 4.5-5 µm, ovoid to ellipsoid, slightly rhomboid in face-view, sub-ellipsoid in side view, yellowish brown, thin-walled, with a reduced germ pore. **Basidia** 20-26 x 6-7.5 µm, ventricose, 4-spored, hyaline. **Pleurocystidia**

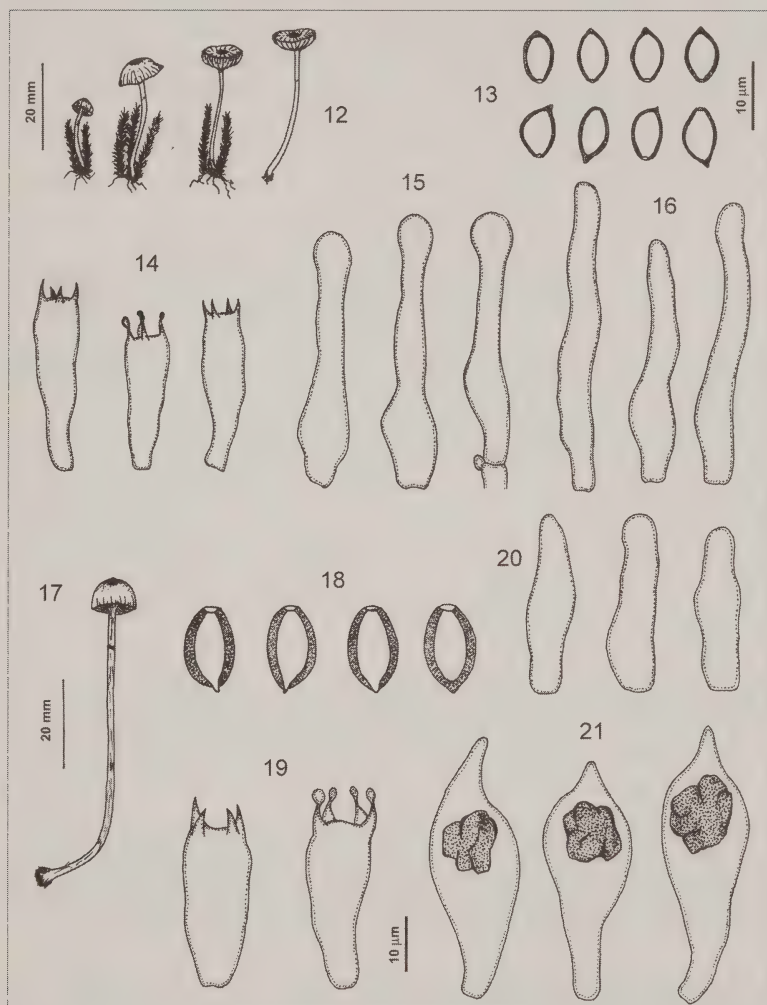


Figure 12-21. 12-16. *Psilocybe muscorum*. 12. Basidiomes. 13. Basidiospores. 14. Basidia.
15. Cheilocystidia. 16. Caulocystidia.
17-21. *Stropharia alcis*. 17. Basidiome. 18. Basidiospores. 19. Basidia.
20. Cheilocystidia. 21. Pleurocystidia.

absent. **Cheilocystidia** 25-56 x 5-9 μm , cylindrical to lageniform, hyaline, thin-walled, forming a sterile band in the gill edge. **Hymenophoral trama** subregular, with hyaline hyphae 5.5-8 μm wide. **Pileipellis** as an ixocutis composed of hyaline and gelatinized hyphae, thin-walled, elongated, 3-5 μm wide. **Hypodermium** formed of filamentous to subglobose hyphae, with hyaline to little encrusted walls. **Stipepellis** formed by parallel, hyaline and thin-walled hyphae, 8.5-14 μm wide. **Caulocystidia** 30-55 x 4-6.5 μm , cylindrical to lageniform, also subcapitate, similar to the cheilocystidia, clustered on the stipe apex.

STUDIED COLLECTION - BRAZIL. Rio Grande do Sul State, Viamão, Itapuã Park, 17.08.2004, *Cortez 048/04* (ICN); among mosses on sandy soil.

Remarks: According to Watling & Gregory (1987), the distribution of this species is unclear because of the taxonomic confusion with other musciculous members of the genus, especially *P. montana* (Pers.: Fr.) P. Kumm. Following Guzmán (1983, 1995), *P. muscorum* exhibits thin-walled basidiospores and belongs to section *Pratensis* Guzmán. *Psilocybe montana* has thick-walled basidiospores and is placed in section *Psilocybe*. *Psilocybe muscorum* was reported by several authors from Europe (e.g., Guzmán et al. 2002, Noordeloos 1999, Orton 1960), and Guzmán (1995) reported it for the first time in South America from Venezuela, at 3.600 m elevation. Our specimens agrees in several aspects with the description given by Guzmán (1983) and Watling & Gregory (1987), however the Brazilian specimens were collected in a subtropical place almost in sea-level, growing associated to mosses in sandy soil. *Psilocybe muscorum* is reported for the first time in Brazil.

7. *Psilocybe wrightii* Guzmán, Mycotaxon 7: 251, 1978.

STUDIED COLLECTIONS - BRAZIL. Rio Grande do Sul State, Viamão, Itapuã Park, 08.05.2004, *P.S. Silva 061/04* (ICN 139.068), *P.S. Silva 062/04* (ICN 139.069); 22.05.2004, *P.S. Silva 085/04* (ICN 139.070), on soil, into the subtropical forest, all the specimens near to a stream.

Remarks: This bluing and probably hallucinogenic species was recently reported from Rio Grande do Sul by Guzmán & Cortez (2004). It has been collected frequently in subtropical forests of Rio Grande do Sul, growing on humid soils. For a complete description and discussion see the above cited work.

8. *Stropharia alcis* Kytövä., Karstenia 39: 17, 1999.

FIG. 17-21

Pileus 8 mm diam., hemispheric, slightly umbonate, yellowish toward the margin to orange-brown in the center, smooth and viscid, margin striate. Lamellae adnexed, dark brown, with entire and whitish edges. Stipe 60 x 2 mm, cylindrical, uniform, yellowish, smooth or with some scales on the base. Veil as a vestigial dark brown annulus, represented by little glutinous fibrils about 7 mm below the pileus.

Basidiospores 13-14 x 7-9 μm , ovoid to ellipsoid in face view and ellipsoid in side view, yellowish brown, thick-walled, with a broad germ pore. **Basidia** 24-29 x 10-12 μm , clavate to ventricose, 4-spored, hyaline. **Pleurocystidia** 30-50 (-54) x 9-15 μm , as chrysocystidia, fusoid, with mucronate apex, and yellowish brown amorphous contents. **Cheilocystidia** 23-35 x 5-8 μm , cylindrical, narrow, hyaline. **Hymenophoral trama** regular, composed of hyaline hyphae 7-13 μm wide. **Pileipellis** as an ixocutis with hyaline and gelatinized hyphae, 6-11 μm wide. **Stipeipellis** formed of parallel, hyaline and thin-walled hyphae, 7-14 μm wide. **Caulocystidia** 30-45 x 4-8 μm , cylindrical to sublageniform, some subcapitate, similar to the cheilocystidia, observed on the stipe apex.

STUDIED COLLECTIONS – BRAZIL. Rio Grande do Sul State, Viamão, Itapuã Park, 16.04.2005, *P.S. Silva 109/05* (ICN 139.083), on soil of subtropical forest. **ADDITIONAL SPECIMEN EXAMINED**: SWEDEN. Province of Dalarnas, St. Kopparberg, 20.09.1980, *S. Jacobsson* (ICN), on elk dung in spruce forest.

Remarks: Kytövuori (1999) described *S. alcis* from the region of Fennoscandia, Finland and his study supported the close relationship of *S. alcis* with elk dung, where it grows alone or mixed with other coprophilous agarics. Kytövuori (1999) also suggested that the distribution of the species must go on toward North America due the presence of the elk there, being rare or absent in south Europe. Our studied material was identified as *S. alcis* because of strongly viscid surface of pileus, long stipe, basidiospore size and cheilocystidia size/shape, in agreement to the description by Kytövuori (1999). However, the Brazilian studied material was collected on soil instead of elk dung. We propose that this species is not restricted to elk dung. Comparative study of Swedish material collected on elk dung did not presented any significant morphological differences, supporting the identification. In this way, *Stropharia alcis* is recorded for the first time for South America and on soil.

9. *Stropharia coronilla* (Bull. ex DC.: Fr.) Quél., Mém. Soc. D'Emul. Mont. Ser. II, 5: 255, 1872.

STUDIED COLLECTIONS – BRAZIL. Rio Grande do Sul State, Viamão, Itapuã Park, 08.05.2004, *P.S. Silva 063/04* (ICN 139.075), *P.S. Silva 064/04* (ICN 139.076), *P.S. Silva 065/04* (ICN 139.077), *P.S. Silva 067/04* (ICN 139.078); 09.04.2005 *P.S. Silva 098/05* (ICN 139.073), *P.S. Silva 099/05* (ICN 139.072), *P.S. Silva 100/05* (ICN 139.074) and *P.S. Silva 114/05* (ICN 139.079), in meadows, among grasses on soil.

Remarks: This is the most common species of the family in the area, frequently collected in meadows. A description of this mushroom is found in Cortez & Coelho (2004).

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Validation of *Auritella* (*Inocybaceae*, *Agaricales*)

P. BRANDON MATHENY^{1*} & NEALE L. BOUGHER²

*pmatheny@clarku.edu

¹Biology Department, Clark University
950 Main St., Worcester, MA 01610, USA

²Department of Environment and Conservation, Western Australian Herbarium
Locked Bag 104, Bentley Delivery Centre, WA 6983, Australia

Abstract—In their original publication, *Auritella geoaustralis*, *A. serpentinocystis*, *A. chamaecephala*, and *A. dolichocystis* (type) were designated as provisional names. To ensure the validity of the generic name *Auritella* and three recombinations into the genus, the four provisional names are validated in accordance with ICBN Article 34.1.

Key words—*Inocybe*, nomenclature

Introduction

A new genus of *Agaricales* in the family *Inocybaceae*, *Auritella*, in which seven species were recognized, was recently published (Matheny & Bougher 2006). Detailed morphological descriptions, Latin diagnoses, DNA sequences, and type designations were provided in this publication, however, the names of the type (*A. dolichocystis*) and three other newly described species were unintentionally designated as provisional names (“nom. prov.” instead of “sp. nov.”). According to ICBN Article 34.1(b) (Greuter et al. 2000), these four names were not validly published. Consequently, the generic name was not properly typified and is also invalid (Art. 6.3, 10.1, 10.3, 12.1, 37.1), resulting in the invalidity of the new combinations based upon previously described taxa. Here we accept all of the taxa and validate all of their names. Per Art. 36.1 it is unnecessary to repeat the Latin descriptions but refer to those published in Matheny & Bougher (2006).

Materials and methods

Herbarium abbreviations follow Holmgren et al. (1990).

Taxonomy

***Auritella* Matheny & Bougher, gen. nov.**

"*Auritella*", Mycol. Prog. 5: 5, figs. 2–4. 2006 (inval. Art. 10.1, 10.3, 37.1).

Typus Auritella dolichocystis Matheny, Trappe & Bougher

***Auritella aureoplumosa* (Watling) Matheny, comb. nov.**

Inocybe aureoplumosa Watling, Czech Mycology 52: 331. 2001 (basionym).

"*Auritella aureopluma*", Mycol. Prog. 5: 5. 2006 (inval. Art. 43.1).

***Auritella erythroxa* (De Seynes) Matheny, comb. nov.**

Inocybe erythroxa De Seynes, Rech. Champ. Congo Fr. 1: 2. 1897 (basionym).

"*Auritella erythroxa*", Mycol. Prog. 5: 7. 2006 (inval. Art. 43.1).

***Auritella geoaustralis* Matheny & Bougher, sp. nov.**

"*Auritella geoaustralis*", Mycol. Prog. 5: 7. 2006 (inval. Art. 34.1).

Holotypus in PERTH (H7344), *isotypus* in WTU.

***Auritella arenicolens* (Cleland) Matheny & Bougher, comb. nov.**

Naucoria arenacolens Cleland, Trans. R. Soc.S. Australia 57: 193. 1933 (basionym).

Inocybe arenacolens (Cleland) E. Horak, Persoonia 11: 6. 1980.

"*Auritella arenacolens*" Mycol. Prog. 5: 8. 2006 (inval. Art. 43.1).

NOTE: The spelling of the specific epithet "*arenacolens*" is an orthographic error, which is corrected to "*arenicolens*" according to Art. 60.8 and Recommendation 60G1(a).

***Auritella serpentinocystis* Matheny, Trappe & Bougher, sp. nov.**

"*Auritella serpentinocystis*", Mycol. Prog. 5: 9. 2006 (inval. Art. 34.1).

Holotypus in PERTH (Trappe 25080), *isotypus* in WTU.

***Auritella dolichocystis* Matheny, Trappe & Bougher, sp. nov.**

"*Auritella dolichocystis*", Mycol. Prog. 5: 9. 2006 (inval. Art. 34.1).

Holotypus in PERTH (Trappe 24838), *isotypus* in WTU.

***Auritella chamaecephala* Matheny, O. K. Mill. & Bougher, sp. nov.**

"*Auritella chamaecephala*", Mycol. Prog. 5: 11. 2006 (inval. Art. 34.1).

Holotypus in VPI (OKM 23901), *isotypus* in WTU.

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Cordyceps mrciensis sp. nov. from a spider in Thailand

OHNMAR MYO AUNG^{1, 2}, JI CHUAN KANG³,
ZONG QI LIANG⁴, KASEM SOYTONG² & KEVIN DAVID HYDE⁵

*jichuank@yahoo.co.uk

¹ Biocontrol Research Unit and Mycology Section
Department of Plant Pest Management, Faculty of Agricultural Technology
King Mongkut's Institute of Technology Ladkrabang (KMITL)
Bangkok 10520, Thailand

² Mushroom Research Foundation
128 Moo3, Bahn Pha Daeng, T. Pa Pae, A. Mae Taeng
Chiang Mai 50150, Thailand

³ The Research Center of Biochemistry, Guizhou University
Guiyang 550025, Guizhou Province, PR China

⁴ College of Biological Technology, Guizhou University
Guiyang 550025, Guizhou Province, PR China

⁵ Centre for Research in Fungal Diversity
Department of Ecology & Biodiversity, The University of Hong Kong
Pokfulam Road, Hong Kong, PR China

Abstract—A fungus associated with a spider collected from the Mushroom Research Centre, Chiang Mai, Thailand was found to represent a new species of the genus *Cordyceps*. It is described as *C. mrciensis* sp. nov. *C. mrciensis* differs from other species occurring on spiders in that the stromata have a fertile part with a distinctive sterile appendage, superficial perithecia and ascospores that do not break into secondary partspores.

Key words—entomogenous fungi

Introduction

Cordyceps is a morphologically and ecologically well-defined group of parasites on arthropods (insects, spiders and mites) and hypogeous fungi (Kobayasi 1941, 1982, Mains 1954, 1957, Kobayasi & Shimizu 1960, 1977, Evans 1982, Zhang et al. 2004, Stensrud et al. 2005). This genus is one of the two most important genera of invertebrate pathogens (Hywel-Jones 2001) and is cosmopolitan in

* Corresponding author

distribution (Hawksworth et al. 1995). Kirk et al. (2001) suggested that there are 100 *Cordyceps* species, although 280 species were listed by Kobayasi (1982). According to Index Fungorum (www.Indexfungorum.org), more than 500 epithets are assigned to *Cordyceps*, however, many are known to be taxonomic synonyms.

In Thailand, 26 species of *Cordyceps* have been identified, including four species on spiders (Hywel-Jones 2001). Kobayasi (1962) recorded five *Cordyceps* species parasitizing spiders (Arachnida) worldwide. Mains (1954) listed eight species of *Cordyceps* known to parasitize spiders.

While collecting entomogenous fungi in northern Thailand forests, a new *Cordyceps* species was found parasitizing a spider. This species is distinct from all other *Cordyceps* species and represents a novel taxon.

Materials and methods

Collections were made at the Mushroom Research Centre (MRC) in northern Thailand. Soil, litter, herbs, and trees, including the under sides of leaves were examined and dead and infected insects were collected. Specimens were stored in plastic containers and transported on the same day to the laboratory for identification. The holotype is now deposited in the Thai Mycological Association Herbarium (TMAH).

Taxonomic description

Cordyceps mrciensis Aung, J.C. Kang, Z.Q. Liang, Soyong & K.D. Hyde **sp. nov.**

[MB 510252]

FIGURES 1 & 2

Stromata e abdomine hospitis oriunda, ramosa, filiformia, 5-12 mm longa. Pars fertilis nigrescens. Appendix apicalis filiformis 4 mm longa. Perithecia superficialia, elongata vel ellipsoidea, 210-375 × 150-180 µm. Asci 135-306 × 9-15 µm, capitibus 5.4-8.4 µm in diam. Ascospores 185-435 × 3-5 µm, multiseptatae, cellulis 3.6-21 µm longis, non-separabilis.

Etymology: *mrciensis* = refers to the Mushroom Research Centre (MRC), the locality where the specimen was found.

Holotype: Thailand, Chiang Mai, Mae Taeng, T. Pa Pae, Bahn Pha Daeng, 128 Moo 3, Mushroom Research Centre, from spider (Arachnida) attached to a rotten bamboo culm, 17 September 2005, Ohnmar Myo Aung TMAH 0001. The holotype is deposited in Thai Mycological Association Herbarium (TMAH).

Stomata arising from abdomen of infected spider, filiform, 5-12 mm long, light brown, branching. **Fertile part** black, with a 4 mm long sterile appendage. **Perithecia** superficial, elongate to ellipsoid, 210-375 × 150-180 µm, some with a short neck, about 120 × 30 µm. **Asci** filiform, 8-spored, 135-305 × 9-15 µm; caps of asci 4.2-6.6 µm high, 5.4-8.4 µm wide. **Ascospores** filiform, 185-435 × 3-5 µm, not breaking into secondary ascospores, septate at 3.6-21 µm intervals.



Fig 1. *Cordyceps mrciensis* A. Upper part of an ascus with mature ascospores.
B. An ascus with filiform ascospores. Bars = 5 μm .

Discussion

Cordyceps mrciensis was associated with a single infected spider, attached to a rotten bamboo culm, collected at Mushroom Research Centre, Chiang Mai, Thailand.

Most *Cordyceps* species are believed to be specific to various arthropod groups, such as spiders with the degree of specificity differing from species to species (Nikoh & Fukatsu 2000). Therefore, our discussion will be based only on *Cordyceps* species associated with spiders (Arachnida).

According to Mains (1954) only eight species of *Cordyceps* have been recorded in association with spiders. *Cordyceps mrciensis* can be distinguished from these known species in having stromata with a fertile part and a stipe that continues as a distinctive sterile appendage, superficial perithecia and ascospores that do not break into partspores. There are only two species, *C. thaxteri* Mains and *C. engleriana* Henn., that have superficial perithecia. In *C. thaxteri* the perithecia are scattered, free, narrowly ovoid, and large (960-1200 x 300-360 μm , Mains,

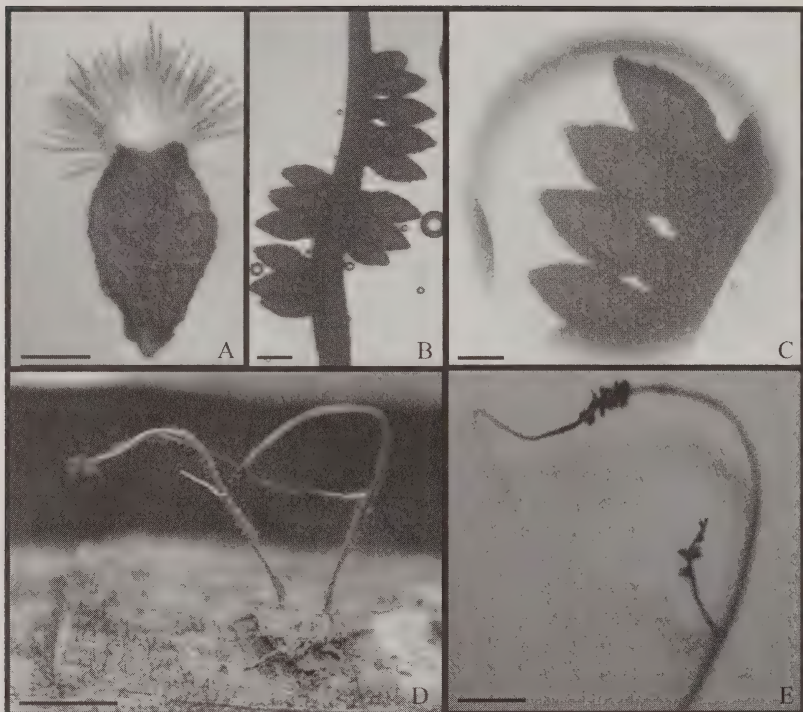


Fig 2. *Cordyceps mrciensis* (from holotype). A. A perithecium and asci. B. Superficial perithecia. C. Perithecia. D. Small spider bearing two stromata with superficial perithecia. E. Appendage. Bars: A & C = 100 μ m, B = 200 μ m, D & E = 2.5 mm.

1954). The perithecia of *C. engleriana* are also superficial, but crowded at the apex of the stromata and ovoid or flask-shaped (Mains 1954). *Cordyceps mrciensis* also has superficial perithecia but they are elongate to ellipsoid, small, $210\text{--}375 \times 150\text{--}180 \mu\text{m}$ and some have short necks. The ascospores of *C. thaxteri* and *C. engleriana* break into partspores, whereas those of *C. mrciensis* do not. *Cordyceps caloceroides* Berk. & M.A. Curtis and *C. grenadensis* Mains, also associated with spiders, possess ascospores that do not break into secondary partspores. *Cordyceps caloceroides* has immersed perithecia with slightly protruding ostioles, while *C. grenadensis* has partly imbedded, ovoid perithecia. The perithecia of *C. mrciensis* are entirely superficial and somewhat scattered on the stipe.

Besides the above characters, the distinctive fertile part of the stroma with a distinctive sterile appendage is sufficient to distinguish *C. mrciensis* from the known *Cordyceps* species from spiders (Table 1).

Table 1. Comparison of the characteristics of *Cordyceps* species associated with spiders

Species	Stroma	Perithecia (range in μm)	Ascospores (range in μm)	Reference
<i>C. arachneicola</i>	Cylindric, 50 $\times$ 2 mm	Completely embedded ellipsoid	-	Kobayasi 1941. Tokyo Bun. Daig. 5 no. 84: 123-125
<i>C. caloceroides</i>	Bright red, furcate, nearly 5 in long, $\leq$ 1 line thick	Immersed, prominent ostioles, ovoid, 215-250 $\times$ 100-150	Not breaking into partspores	Berk. & M.A. Curtis 1868. Jour. Linn. Soc. Bot. 10: 375
<i>C. cylindrica</i>	Cylindric, capitate, twisted-rounded apex 15 $\times$ 1.5-2.0 mm	Entirely embedded to the surface or at right angles to the surface 850-1200 $\times$ 220-270	-	Petch 1937. Trans British Myc. Soc. 21: 46
<i>C. engleriana</i>	Many, 15 $\times$ 0.25 mm	Superficial, crowded, free, ovoid or flask shaped, 600 $\times$ 300	Breaking into 22-25 $\times$ 1.5-2 μm cylindric fragments	Henn. 1897. Engler Bot. Jahrb. 23: 538
<i>C. grenadensis</i>	2, ovoid, cylindric 10-12 mm	Partly embedded, ovoid, 336-360 $\times$ 156-216	Not breaking into partspores	Mains 1954, Bull. Torrey Bot. Club 81: 492-500
<i>C. ignota</i>	Simple, branched, slender, 60 $\times$ 0.5-1.5 mm	Slightly embedded, very crowded, ovoid 100-140 $\times$ 60-75	-	Marchion. 1945. Physis 20: 17
<i>C. mrciensis</i>	2, branching, filiform, 5-12 mm	Superficial, elongate, ellipsoid, some with short neck, 210-375 $\times$ 150-180, 4 mm sterile appendage	Not breaking into partspores	sp. nov.
<i>C. singeri</i>	Clavate, subcapitate, 3-12 mm	Embedded, ovoid, 325-550 $\times$ 200-500	Breaking into one-cell segments- 3-4 $\times$ 0.7-1	Mains 1954, Bull. Torrey Bot. Club 81: 492-500
<i>C. thaxteri</i>	Subcylindric, 1.5-2.5 $\times$ 0.1-0.2 mm	Superficial, few, narrowly ovoid, 960-1200 $\times$ 300-360	Breaking into one-cell segments	Mains 1939. Jour. Elisha Mitchell Soc. 55: 120

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A new entomopathogenic species, *Hymenostilbe furcata*, parasitic on a hemipteran nymph in northern Thailand

OHNMAR MYO AUNG^{1, 2}, JI CHUAN KANG^{3*},
ZONG QI LIANG⁴, KASEM SOYTONG² & KEVIN DAVID HYDE⁵

Jichuank@yahoo.co.uk

¹ Biocontrol Research Unit and Mycology Section
Department of Plant Pest Management, Faculty of Agricultural Technology
King Mongkut's Institute of Technology Ladkrabang (KMITL)
Bangkok 10520, Thailand

² Mushroom Research Foundation, 128 Moo3, Bahn Pha Daeng, T. Pa Pae
A. Mae Taeng, Chiang Mai 50150, Thailand

³ The Research Center of Biochemistry, Guizhou University
Guiyang 550025, Guizhou Province, PR China

⁴ College of Biological Technology, Guizhou University
Guiyang 550025, Guizhou Province, PR China

⁵ Centre for Research in Fungal Diversity: Ecology & Biodiversity
The University of Hong Kong, Pokfulam Road, Hong Kong, PR China

Abstract—*Hymenostilbe furcata* sp. nov., parasitic on a hemipteran nymph in a northern Thailand forest is described and illustrated. Its morphology is compared with that of other species with forked denticles.

Key words—hyphomycete genus

Introduction

The entomopathogenic hyphomycete genus *Hymenostilbe* was introduced by Petch (1931) to accommodate *H. muscarium* Petch, a species parasitic on dipteran insects. It was described as having cylindrical synnemata covered by a hymenium-like layer of conidiogenous cells (Samson & Evans 1975). It was later found to be the anamorph of *Cordyceps forquignonii* Quél. (Petch 1948). *Hymenostilbe* species can be distinguished from *Akanthomyces* species, also parasitic on insects and spiders, as the conidia of *Akanthomyces* form in chains on phialides, while those of *Hymenostilbe* are solitary, polyblastic and form on a denticle (Petch 1932c, Mains 1950, Samson & Evans 1975). *Akanthomyces*

*Corresponding author

and *Hymenostilbe* produce synnemata that are more or less cylindric and often are somewhat attenuated towards the apex. In *Hymenostilbe* the synnemata are composed of more or less parallel, longitudinal hyphae, usually forming a compact bundle. The longitudinal hyphae produce conidiogenous cells at their ends, especially in the upper portions of the synnemata. Most of the conidiogenous cells, however, are produced either as lateral cells or frequently as terminal cells of short lateral branches produced along the entire length of the outer hyphae of the synnemata. This results in a hymenial layer that covers the surface of the synnemata. In most species there is abundant production of conidiogenous cells resulting in a compact hymenial layer. In some species the conidiogenous cells are scattered and well separated from each other (Mains 1950).

Samson & Evans (1975) reviewed *Hymenostilbe* accepting nine species and excluding 11 doubtful species. *Hymenostilbe* species parasitize arachnids and dipteran, orthopteran and hymenopteran insects. *Hymenostilbe longispora* Samson & H.C. Evans is commonly found on several ant species of the subfamilies Ponerinae and Myrmicinae. *H. ghanensis* Samson & H.C. Evans was collected on a spider. Several species of *Hymenostilbe* have been associated with a *Cordyceps* teleomorph. For instance, *H. dipterigena* Petch is the anamorph of *Cordyceps dipterigena* Berk. & Broome (Petch 1932a), *H. nutans* Samson & H.C. Evans is the anamorph of *C. nutans* Pat. and *H. fragilis* Petch is the anamorph of *C. uleana* Henn. (Petch 1932b). Three species of *Hymenostilbe* have been recorded in Thailand; *H. ventricosa* Hywel-Jones was rarely found as an entomopathogen of cockroach nymphs (Hywel-Jones 1995), while *H. aurantiaca* Hywel-Jones was found on formicine ants in the same location as *C. cf. myrmecophila* Ces. (Hywel-Jones 1996).

Based on the previous records and distinctive morphological characteristics, the fungus described in this paper is accommodated in *Hymenostilbe* as a new species.

Materials and methods

A general survey of entomopathogenic fungi was carried out in northern Thailand forests from May to October 2005. The collection sites included in this survey were Mushroom Research Centre (MRC), Doi Suthep National Park, Mokfa Waterfall and Toung Jaw Village, Chiang Mai. Soils, litter, herbaceous plants, and tree leaves were examined for dead insects, which were collected and transported the same day to the laboratory in plastic containers for identification and isolation. Conidial isolations were made on potato dextrose agar (PDA). The holotype is deposited in Thai Mycological Association Herbarium (TMAH).

Taxonomic description

Hymenostilbe furcata Aung, J.C. Kang, Z.Q. Liang, Soytong & K.D. Hyde **sp. nov.**

[MB 510253]

FIGURES 1-2

Synnemata multiplicata, *oriunda corpa*, *alba*, *cylindrica*, 10-14 mm longa, 94-120 µm crassa. *Cellulae conidiogenae* 5-18 × 3.5-6.5 µm, *polyblasticae*, *clavata vel cylindrica*, *sursum denticulis furcatis* 0.6-2.4 µm longis dense obiectae. *Conidia solitaria*, *levia*, *hyalina*, *fusiformis*, 8.5-15 µm longa, 3- 4.5 µm crassa.

Etymology: The species name refers to the forked sterigmata-like projections from the conidiogenous cells.

Holotype: Thailand, Chiang Mai, Mae Taeng, T. Pa Pae, Bahn Pha Daeng, 128 Moo 3, Mushroom Research Centre, from hemipteran nymph (Hemiptera) attached to the underside of a leaf in forest, 25 June 2005, Ohnmar Myo Aung TMAH 0002.

Synnemata slender, 10-14 mm long, 94-120 µm wide, arising from head and thorax of insect, cylindrical, white; central core of parallel hyphae composed of cells 3-55 × 2.5-4 µm; covered by an outer hymenium-like layer of conidiogenous cells with basal cells 7.5-20 × 2.5-5 µm. Conidiogenous cells 5-18 × 3.5-6.5 µm, polyblastic, clavate or cylindrical, apically with 2-7 furcellate denticles, 0.6-2.4 µm. Conidia 8.5-15 × 3- 4.5 µm, solitary, smooth, hyaline, fusiform.

Unfortunately, attempts to culture *H. furcata* on agar were unsuccessful.

Discussion

Species in the entomopathogenic genus *Hymenostilbe* are rarely encountered in the tropics (Hywel-Jones 1995). *Hymenostilbe furcata* was collected only once on a hemipteran nymph in the rain forests in Thailand. It can be separated from *H. sulphurea* and *H. nutans*, which also occur on hemipteran insects, by the creamy white synnemata and the two to seven, forked denticles on the conidiogenous cells. *Hymenostilbe sulphurea* Samson & H.C. Evans has sulphur-yellow synnemata and subglobose to ellipsoidal, rough-walled conidia, while *H. furcata* has smooth, fusiform conidia. *Hymenostilbe nutans* has fusoid conidia but they are smaller than those of *H. furcata* (6-10 × 3.2-4 µm vs. 8.5-15 × 3-4.5 µm). The conidiogenous cells of *H. furcata* are clavate or cylindrical while those of *H. nutans* are cylindrical, apically pointed and the denticles are crowded at the apex. The conidiogenous cells of *H. furcata* are 5-18 µm long × 3.5-6.5 µm wide, whereas those of *H. nutans* are 15-24 µm long × 4.5-6.5 µm wide. Those of *H. sulphurea* are cylindrical to clavate, 15-25 × 5-6.5 µm and the denticles are crowded at the apex (Samson & Evans 1975).



Fig.1: *Hymenostilbe furcata* (from holotype). A. Detached conidia. B. Infected hemipteran insect with synnemata. C. Conidia. D. Conidiogenous cell with forked denticles and conidium. E. Conidiogenous cells forming a hymenium-like layer. Scale bars: A, C, D & E = 5 μ m, B = 5 mm.



Fig. 2: Conidiogenous cells of *Hymenostilbe furcata* (from holotype).
Scale bar = 5 μ m.

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The genus *Neoerysiphe* in Israel: species composition, host range and distribution

SVITLANA O. VOYTYUK^{1,3}, VASYL P. HELUTA²,
SOLOMON P. WASSER^{2,3} & EVIATAR NEVO³

voytyuk@research.haifa.ac.il

¹Biological Faculty of Taras Shevchenko Kiev National University
64 Volodymyrska St., Kiev 01033, Ukraine

²M.G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine
2 Tereshchenkivska St., Kiev 01601, Ukraine

³Institute of Evolution, University of Haifa
Mt. Carmel, Haifa 31905, Israel

Abstract—Information on the distribution of *Neoerysiphe* species (*N. cumminsiana*, *N. galeopsidis*, and *N. galii*) is given. It is clearly shown that *N. cumminsiana* is a common species in Israel. Collections of this species were previously referred to *Erysiphe cichoracearum*. Hence, it can be supposed that *Neoerysiphe cumminsiana* is probably widespread in other Mediterranean countries. Therefore, all samples of powdery mildews collected on species of the *Asteraceae* should be critically revised.

Key words—*Erysiphales*, *Neoerysiphe*, species composition

Introduction

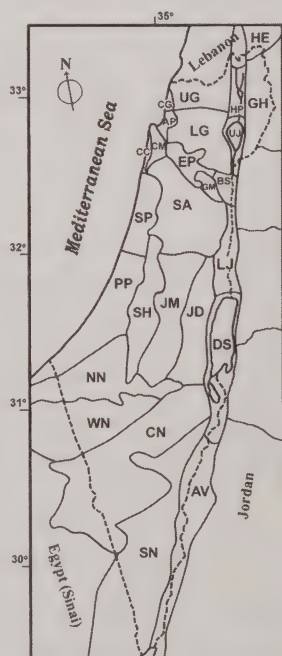
Based on the results of molecular investigations, significant nomenclature changes in the system of *Erysiphales* have recently been made (Takamatsu et al. 1998, 1999, 2000; Saenz & Taylor 1999; Mori et al. 2000), including the introduction of the new genus *Neoerysiphe* U. Braun for the former *Erysiphe* sect. *Galeopsidis* U. Braun. Five species of *Erysiphe* s.l. (*E. chelones* Schwein., *E. cumminsiana* U. Braun, *E. galeopsidis* DC., *E. galii* S. Blumer, and *E. geranii* Y. Nomura) were transferred to the new genus (Braun 1999). According to molecular phylogenetic data, these five species form a separate clade (Saenz & Taylor 1999) and they have a specific anamorph type, *Oidium* subgen. *Striatoidium* R.T.A. Cook et al., with striate conidial walls (Gorter 1987; Cook et al. 1997). Furthermore, species of this genus have some biological feature such as chasmothecia which became mature only after overwintering. *Neoerysiphe* species are differentiated by some morphological characters and different

*Corresponding author: voytyuk@research.haifa.ac.il

host ranges. Thus, *N. cumminsiana* infects species of the *Asteraceae* belonging to *Arctotheca*, *Bidens*, *Cacalia*, *Crepis*, *Eupatorium*, *Heliopsis*, *Ligularia*, *Phagnalon*, *Rhagadiolus*, *Senecio*, *Tagetes*, and *Taraxacum* (Amano 1986; Braun 1987; Heluta 1999; Voityuk et al. 2004a). *Neoerysiphe galii* is confined to species of *Galium* (*Rubiaceae*) (Braun 1987; Voityuk et al. 2004b), and *N. galeopsidis*, affects, according to Braun (1987), species of the genera *Ballota*, *Betonica*, *Chelonopsis*, *Clinopodium*, *Comanthosphace*, *Elsholtzia*, *Galeobdolon*, *Galeopsis*, *Glechoma*, *Isodon*, *Lagopsis*, *Lamium*, *Leonurus*, *Leucas*, *Lycopus*, *Marrubium*, *Melissa*, *Melittis*, *Monarda*, *Nepeta*, *Origanum*, *Phlomis*, *Physostegia*, *Plectranthus*, *Prunella*, *Rosmarinus*, *Salvia*, *Satureja*, *Scutellaria*, *Sideritis*, *Stachyopsis*, *Stachys*, *Thymus*, *Ziziphora* (*Lamiaceae*). In Israel, only species of the genus *Golovinomyces* (U. Braun) Heluta have been collected on hosts of the genera *Lycopus*, *Monarda*, *Nepeta*, *Rosmarinus*, *Salvia*, *Thymus* and *Ziziphora*. Therefore, the occurrence of *N. galeopsidis* on hosts of these genera is somewhat doubtful and should be proven. *Neoerysiphe chelones* (Schwein.) U. Braun is only known from *Chelone glabra* (*Scrophulariaceae*), and *N. geranii* (Y. Nomura) U. Braun is confined to the genus *Geranium* (*Geraniaceae*) (Braun 1987; Heluta 2001).

Among species of *Neoerysiphe*, the most widespread are *N. galeopsidis* (nearly circumglobal) and *N. galii* (all of Europe, Central Asia, China, Balearic and Canary Islands). *Neoerysiphe chelones* is known only in North America, and *N. cumminsiana* is recorded from North America and Japan (Braun 1987). However, as shown by Heluta (1999), the later species occurs also in Europe (Ukraine). Heluta (2001) discovered *N. geranii*, previously only known from Japan and New Zealand, in the Ukraine, showing that this species is much more widespread than hitherto assumed. These results were the reason for our detailed examinations of *Neoerysiphe* species in Israel.

Figure 1: Accepted abbreviations of nature regions of Israel: AP – Akko Plain; AV – Arava Valley; BS – Beit Shean Valley; CC – Carmel Coast; CG – Coast Galilee; CM – Carmel Mount; CN – Central Negev; DS – Dead Sea Area; EP – Esdraelon (Yizre'el) Plain; GH – Golan Heights; GM – Gilboa Mount; HE – Hermon Mount; HP – Hula Plain; JD – Judean Desert; JM – Judean Mts.; LG – Lower Galilee; LJ – Lower Jordan Valley; NN – Northern Negev; PP – Philistean Plain; SA – Samaria; SH – Shefela; SN – South Negev; SP – Sharon Plain; UG – Upper Galilee; UJ – Upper Jordan Valley; WN – Western Negev (Feinbrun-Dothan & Danin 1998).



Materials and methods

In this research samples from the herbarium of the Hebrew University of Jerusalem (HUJ) and specimens collected by the authors themselves in Israel between 2002 and 2005 were used. A map showing the nature regions of Israel (Fig. 1), used as base to demonstrate the distribution of each species in this country, is provided. Morphological features of the *Neoerysiphe* species were examined by using light dark-field (Carl Zeiss Axiostar 1122-100, Germany) and scanning microscopes (JSM-35C and Jeol JSM-6060LA, Japan). Names of host plants are given according to Feinbrun-Dothan and Danin (1998).

Results and discussion

As a result of field investigations, *N. cumminsiana* was recorded from several localities in Israel (Voityuk et al. 2004a). Later *N. galii* was also found for the first time in this country (Voityuk et al. 2004b). A preliminary analysis of literature data (Rayss 1940, 1947, 1953, 1959; Chorin & Palti 1962) showed that *N. cumminsiana* was probably misidentified as *Erysiphe cichoracearum* DC. In order to check this hypothesis, all herbarium samples collected in the last century in Israel and kept in the herbarium of the Jerusalem Hebrew University (HUJ) were re-examined. In addition, different regions of the country were searched for *Neoerysiphe* spp. Finally, it was demonstrated that three species of the genus *Neoerysiphe* are distributed in Israel: *N. cumminsiana*, *N. galeopsidis* and *N. galii*. Numerous samples of *N. cumminsiana* and *N. galeopsidis* referred to as *Erysiphe cichoracearum*, *E. biocellata* Ehrenb., *E. fischeri* S. Blumer, *E. galeopsidis*, and *Oidium gigasporum* Scalia were found in herbarium HUJ. One of the samples of *N. cumminsiana* on *Phagnalon rupestre* was originally identified as *Leveillula taurica* (Lév.) G. Arnaud.

Numerous additional localities of *Neoerysiphe* species in Israel as well as new host plants were found, e.g., *Carthamus tenuis*, *Filago eriocephala*, *Hedypnois cretica*, *Lagoseris sancta*, *Picris altissima*, *P. amalecitana*, *P. galilaea*, *Tolpis virgata* and *Thrinia tuberosa*, for *N. cumminsiana*, and *Prasium majus* new for *E. galeopsidis*.

The following descriptions, illustrations and distribution maps of all *Neoerysiphe* species known from Israel are generally based on the collections examined and cited.

Neoerysiphe cumminsiana (U. Braun) U. Braun, Schlechtendalia 3: 50 (1999)

(Fig. 3)

Mycelium on stems, leaves, effuse or in patches, evanescent to subpersistent. Hyphae septate, 4–10 µm in wide. Appressoria mainly lobed. Anamorph *Oidium* s. str. Conidiophores erect, 150–190 µm (fresh material), foot-cells

straight, cylindrical, (35–) 37–70 × 11–14 µm. Conidia in chains, ellipsoid, after drying cylindrical-ellipsoid to vase-like, 25–38 × (10–) 13–20 µm (dry material), 30–40 × 17–25 µm (fresh material). Chasmothecia scattered or in large groups, hemispheric, depressed in the lower part, 80–170 µm in diam. Peridium cells polyangular, 2–15 (–19) µm in diam. Appendages in the lower part of the ascocarp, number variable, few to numerous, (0.25–) 0.5–1.5 times as long as the chasmothecia diam, often shorter than the chasmothecium diam, 4–10 µm in wide, thin-walled, mycelium-like, septate, hyaline, later yellowish. Asci numerous, 6–16, thin-walled, stalked, 40–67 (–75) × 20–35 (–40) µm. Ascospores not developed.

Distribution in Israel (Fig. 2):

On *Carthamus tenuis* (Boiss. & Blanche) Bornm. – JM: Jerusalem, 26.05.1945, E. Zwirn (HJ 7027) (Rayss 1947).

On *Crepis aculeata* (DC.) Boiss. – PP: Rehovot, 24.03.1951, T. Rayss (HJ 301/9 94S). – SA: Herzliya, 29.03.1951, T. Rayss (HJ 301/9 97S). – Israel (Amano 1986).

On *Crepis aspera* L. – CC: 'Atlit, Coast Sea, 32°42'N, 34°56'E, 26.03., 05.04., 21.04., 27.04.2004, S.O. Voytyuk – CM: Canyon between Haifa and 'Atlit (road to the Mediterranean Sea from University of Haifa), 31°24'N, 34°52'E, 27.04.2004, S.O. Voytyuk; Haifa, University of Haifa, near Institute of Evolution, 22.04.2004, S.O. Voytyuk. – JM: Jerusalem, 05.06.1950, T. Rayss (HJ 301/9 96S); Jerusalem, 17.05.1940, T. Rayss (HJ 657) (Rayss 1940); Moza (5 km west of Jerusalem), 18.04.1939, T. Rayss (HJ 665) (Rayss 1940). – PP: Petah Tiqwa (10 km east of Tel-Aviv), 26.04.1930, T. Rayss (HJ 301/12 109S); Qevuzat Yavne, 09.04.1938, T. Rayss (HJ 7710), 12.04.1946, T. Rayss (HJ 7219); Tel-Aviv, 17.04.1946, T. Rayss (HJ 7223). – SP: Herzliya (between Tel-Aviv and Netanya), 06.04.1939, M. Futurian (HJ 663) (Rayss 1940); Pardes Hanna-Karkur, 05.04.1939, S. Duvdevani (HJ 664) (Rayss 1940); Herzliya Pituah, 32°12'N, 34°48'E, 21.04.2004, S.O. Voytyuk. – JV: Nahalal (7 km southeast of Qiryat Tiv'on), 29.03.1942, T. Rayss (HJ 4431). – Israel (Amano 1986).

On *Crepis bulbosa* (L.) Tausch – JM: Jerusalem, 23.05.1957, T. Rayss (HJ 301/13 113S).

On *Crepis palestina* (Boiss.) Bornm. – UG: Wadi Qurein (Qarn), 04.05.1942, T. Rayss (HJ 4851) (Rayss 1947). – Israel (Amano 1986).

On *Crepis sancta* (L.) Bornm. (= *Lagoseris sancta* (L.) K. Maly) – LG: Mi'ilya (near Ma'alot), 33°00'N, 35°08'E, 25.03.2004, S.O. Voytyuk – PP: Rehovot, 24.03.1951, T. Rayss (HJ 301/9 93S; HJ 301/10 100S). – Israel (Amano 1986).

On *Crepis* sp. – CC: 'Atlit, 19.03.2002, V.P. Heluta. – CM: Haifa, 15.03.2002, V.P. Heluta (Voytyuk et al. 2004a). – SP: Pardes Hanna-Karkur, 12.04.2002, E. Nevo

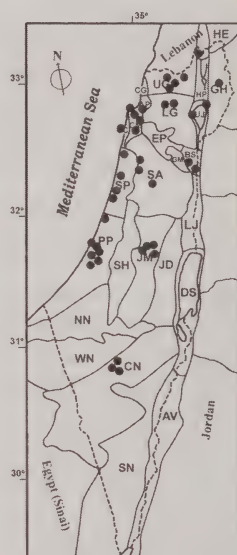


Figure 2: Distribution of *Neoeerysiphe cumminsiana* in Israel

On *Filago eriocephala* Guss. (= *F. germanica* (L.) Huds.) – JM: Jerusalem, 15.05.1939, J. Stettner (HUJ 655) (Rayss 1940). – Israel (Amano 1986).

On *Hedypnois cretica* (L.) Dum.-Courset – CC: near 'Atlit, 31°24'N, 34°52'E, 27.04.2004, S.O. Voytyuk. – CM: Bet Oren, 04.04.1943, T. Rayss (HUJ 6332); Daliyat el Carmiel, 14.04.1941, T. Rayss (HUJ 660); Haifa, 28.03.1936, T. Rayss (HUJ 688). – JV: between Mehola and Bet She'an (7 km from Bet Shean), 32°21'N, 35°32'E, 02.05.2004, S.O. Voytyuk. – Negev: 'En Hawwa (15 km southeast of 'Avedat), 13.03.1945, T. Rayss (HUJ 6849). – PP: Bene Beraq (between Ramat Gan and Petah Tiqwa), 09.03.1938, T. Rayss (HUJ 679). – SA: 05.04.1943, T. Rayss (HUJ 6184). – UG: near 'En Kamonnim, near the road from the Rama village, 32°54'N, 35°26'E, 02.05.2004, S.O. Voytyuk; Mazzuva (kibbutz) (1 km southeast of Hanita Junction), 21.03.1953, T. Rayss (HUJ 301/12 107S); Metulla (on the Lebanon border), 23.04.1935, T. Rayss (HUJ 698). – UJ: 'En Gev (kibbutz on eastern shore of Lake Kinneret), 07.04.1945, T. Rayss (HUJ 7014); Tiberias (on shore of Lake Kinneret), 18.03.1938, T. Rayss (HUJ 678). – Israel, 21.03.1942, T. Rayss (HUJ 4844).

On *Phagnalon rupestre* (L.) DC. – GH: Yehudiyya, near the road, 32°56'N, 35°41'E, 17.05.2004, S.O. Voytyuk. – UG: Mt. Meron, Nahal Keziv, 18.03.2002, T. Andrianova; Zefat (= Safed), 22.08.1953, T. Rayss (HUJ 301/111 147S). – Israel (Amano 1986).

On *Picris altissima* Delile (= *P. sprengeriana* (L.) Chaix) – GH: Avné Etan (near Ramat Magshimim), 32°49'N, 35°46'E, 02.03.2004, S.O. Voytyuk (anamorph). – JM: Qiryat 'Anavim, 28.04.1939, T. Rayss (Rayss 1940). – Israel (Amano 1986).

On *Picris amalecitanica* (Boiss.) Eig. – SP: Kefar Vitkin (6 km north of Netanya), 09.03.1940, T. Rayss (HUJ 658) (Rayss 1940). – Mi'ilya, 33°00'N, 35°08'E, 25.03.2004, S.O. Voytyuk. – Israel (Amano 1986).

On *Picris galilaea* (Boiss.) Eig. – CM: Bet Oren, 05.04.1943, T. Rayss (HUJ 5562) (Rayss 1947). – JM: Qiryat 'Anavim (near Abu Ghosh village), 28.04.1939, T. Rayss (HUJ 667). – Israel (Amano 1986).

On *Rhagadiolus stellatus* DC. – CM: Haifa, 29.03.1936, T. Rayss (HUJ 686) (Rayss 1940). – JM: Jerusalem, 06.04.1937, T. Rayss (HUJ 687), 24.03.1937, T. Rayss (Rayss 1940). – NN: near Lahav, 31°24'N, 34°52'E, 21.03.2004, S.O. Voytyuk – UJ: Tiberias (on shore of Lake Kinneret), 18.03.1938, T. Rayss (HUJ 669) (Rayss 1940). – Israel (Amano 1986).

On *Senecio vernalis* Waldst. & Kit. – CM: Nahal Oren, 32°49'N, 35°46'E, 21.06.2004, S.O. Voytyuk. – CN: 'En Hawwa, 13.03.1945, T. Rayss (HUJ 6910). – PP: Giv'at Brenner, 22.03.1945, T. Rayss (HUJ 7084); Tel-Aviv, 03.01.1935, N. Naftolski (HUJ 301/157 140S); Qevuzat Yavne, 30.03.1945, T. Rayss (HUJ 6865); Rehovot, 05.03.1935, T. Rayss (HUJ 733), 24.03.1951, T. Rayss (HUJ 301/157 138S). – SA: Netanya, 01.03.1937, T. Rayss (HUJ 732); Pardes Hanna-Karkur, 08.04.1945, A. Zurion-Hirsh (HUJ 897), 20.03.1951, T. Rayss (HUJ 301/157 139S). – Israel (Amano 1986).

On *Thrinicia tuberosa* (L.) DC. (= *Leontodon tuberosus* L.) – CM: Muchraka, 17.03.2004, S.O. Voytyuk. – LG: the forest near Alloné Abba (near Qirat Tiv'on), 18.04.2004, S.O. Voytyuk. – PP: Giv'at Brenner, 15.03.1945, T. Rayss (HUJ 7712) (Rayss 1947). – JM: Moza (5 km west of Jerusalem), 19.01.1939, T. Rayss (Rayss 1947), 30.03.1957, T. Rayss (HUJ 301/12 110S); Qiryat 'Anavim, 18.04.1936, T. Rayss (Rayss 1947). – Israel (Amano 1986).

On *Tolpis virgata* (Desf.) Bertol. – LG: the forest near Alloné Abba (near Qiryat Tiv'on), 18.04.2004, S.O. Voytyuk. – UG: near 'En Kamonnim, near the road from the Rama village, 32°54'N, 35°26'E, 02.05.2004, S.O. Voytyuk. – Israel, 21.03.1942, T. Rayss (HUJ 4909).

General distribution: Europe (Ukraine), Asia (Israel, Japan), North America.

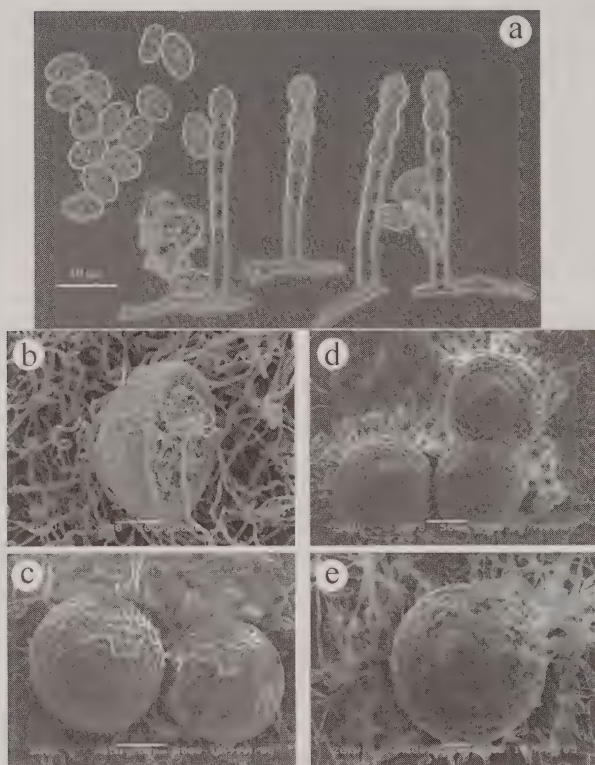


Figure 3: Anamorph (a) and teleomorph (b-e) of *Neoerysiphe cumminsiana*: a – conidiophores and conidia on *Tolpis virgata*, b-e – chasmothecia: b – on *Phagnalon rupestre*, c – on *Hedypnois cretica*, d – on *Picris altissima*, e – on *Tolpis virgata*

Notes: *N. cumminsiana* was previously noted for Israel as *Erysiphe cichoracearum* (Amano 1986; Chorin & Palti 1962, Rayss 1940, 1947, 1953, 1959), *E. fischeri* (Rayss 1946; Chorin & Palti 1962), and *Leveillula taurica* (Rayss 1959; Chorin & Palti 1962).

Chasmothecia of this fungus on *Phagnalon rupestre* were much bigger than those on other host plants. The diameter varied from 130 to 170 μm , average 160 μm . The chasmothecia diameter of the other samples were 80–140 μm in diam. Furthermore, the chasmothecia of the fungus found on *P. rupestre* had smaller peridial cells.

The development of the fungus starts in winter (December to January), and continues until early May when mass production of chasmothecia can be observed.

Neerysiphe galeopsidis (DC.) U. Braun, Schlechtendalia 3: 50 (1999) (Fig. 6a-c)

Mycelium amphigenous, white, sometimes grayish, well-developed on stems, leaves, effuse or in patches, evanescent to subpersistent. Hyphae septate, 4–6 (–8) μm in wide. Appressoria lobed. Anamorph *Oidium* s. str. Conidiophores erect, 95–165 (–180) μm , foot-cells straight, cylindrical, 40–70 $\times$ 10–16 μm (fresh material). Conidia in chains, ellipsoid-ovoid, 19–24 (–30) $\times$ 10–13 (–18) μm (dry material), 25–34 (–40) $\times$ 17–22 μm (fresh material). Chasmothecia numerous, scattered or in groups, 80–140 (–160) μm in diam. Appendages in the basal part of the ascocarp, number variable, few to numerous, 0.5–2 times as long as the chasmothecia diam, often shorter than the chasmothecium diam, 2–8 (–9) μm in wide, thin-walled, mycelium-like, septate, hyaline, later yellowish to brown. Asci 4–12, ellipsoid, shortstalked, 48–85 $\times$ 20–40 μm . Ascospores were not developed.

Distribution in Israel (Fig. 4):

On *Ballota saxatilis* Sieber – JM: Jerusalem, 10.04.1937, T. Rayss (HUJ 740) (Rayss 1940); Jerusalem, Kefar HaShiloah, 24.01.1943, T. Rayss (HUJ 5358) (Rayss 1947). – UG: Rosh Pinna, 27.04.1937, T. Rayss (HUJ 745) (Rayss 1940). – Israel (Rayss 1940, 1947; Amano 1986).

On *Lamium amplexicaule* L. – CM: Haifa, University of Haifa, 10.03.2004, S.O. Voytyuk.

On *Lamium moschatum* Mill. – CC: Bat Shelomo, 12.03.1940, H. Blumenfeld (Rayss 1940). – CM: Bet Oren (kibbutz), 04.04.1943, T. Rayss (HUJ 5515); Nahal Oren, 32°49'N, 35°46'E, 20.04.2004, S.O. Voytyuk; Zikhron Ya'aqov, 25.03.1954, T. Rayss (HUJ 301/46 47S). – HP: Dan (kibbutz, 10 km northeast of Qiryat Shemona), 20.03.1941, T. Rayss (HUJ 734). – JM: Deir esh Sheikh, 12.03.1941, T. Rayss (HUJ 735); Jerusalem, 'En Kerem, 13.04.1950, T. Rayss (HUJ 301/46 50S); Kefar HaShiloah, 09.01.1943, T. Rayss (HUJ 5346); Qiryat 'Anavim (near Abu Ghosh village), 03.04.1941, T. Rayss (HUJ 736). – SA: Hadera, 29.04.1953, T. Rayss (HUJ 301/46 48S). – UG: Zefat, 13.04.1951, T. Rayss (HUJ 301/46 49S). – Israel, 10.04.1946, T. Rayss (HUJ 7215); (Amano 1986).

On *Melissa officinalis* L. – CM: Haifa, University of Haifa, 02.03.2004, S.O. Voytyuk (anamorph). – Israel (Amano 1986).

On *Prasium majus* L. – CC: 'Atlit, 32°42'N, 34°56'E, 21.04.2004, S.O. Voytyuk. – CG: Akhziv Beach (near Naharyya), 33°02'N, 35°05'E, 21.04.2004, S.O. Voytyuk. – CM: Nahal Oren, 13.03.2002 (anamorph), V.P. Heluta. – PP: Tel-Aviv, University of Tel-Aviv, Botanical Garden, 32°06'N, 34°48'E, 21.04.2004, S.O. Voytyuk.

On *Stachys distans* Benth. – CC: 'Atlit, 32°42'N, 34°56'E, 26.03., 21.04., 27.04.2004, S.O. Voytyuk. – CM: Bet Oren (kibbutz), 04.04.1943, T. Rayss (HUJ 5678) (Rayss 1947). – JV: Megiddo (kibbutz), 32°35'N, 35°11'E, 21.06.2004, S.O. Voytyuk. – UG: Mazzuva, 20.03.1953, T. Rayss (HUJ 301/46 46S). – Israel (Amano 1986).

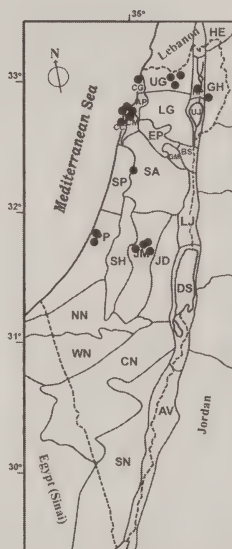


Figure 4: Distribution of *Neerysiphe galeopsidis* in Israel

General distribution: Europe (Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Greece, Hungary, Italy, Norway, Poland, Romania, European part of Russia, Slovak Republic, Spain, Sweden, Switzerland, Ukraine), Asia (Afghanistan, China, India, Iran, Iraq, Israel, Japan, Kazakhstan, Far East of Russia, Turkey), Africa (Canary Islands, Morocco, Republic of South Africa, western Sahara), North America (Bermuda Islands, Canada, USA), New Zealand.

Notes: This species was recorded from Israel as *Erysiphe galeopsidis*, *E. biocellata*, *E. cichoracearum* and *Oidium gigasporum* (Rayss 1940, 1947; Chorin & Palti 1962; Amano 1986).

Neoerysiphe galeopsidis is common and widespread in Israel. Development of the fungus starts during late February and early March, and numerous chasmothecia with dark pigmented appendages are formed on the surface of leaves and stems in early May.

Neoerysiphe galii (S. Blumer) U. Braun, Schlechtendalia 3: 50 (1999) (Fig. 6d)

Mycelium on stems, leaves, effuse or in patches, evanescent to subpersistent. Hyphae septate, (1–) 4–7 (–9) μm in wide. Appressoria nipple-shaped to slightly lobed. Anamorph *Oidium* s. str. Conidiophores erect, foot-cells straight, cylindrical. Conidia in chains, cylindrical to doliform, 19–25 (–38) $\times$ (8–) 10–15 (–18) μm . Chasmothecia scattered, (100–) 120–170 μm in diam. Appendages in the lower part of the ascocarp, number variable, few to numerous, (0.25–)

0.5–1.5 times as long as the chasmothecia diam, often shorter than the chasmothecium diam, 2–9 (–10) μm in wide, thin-walled, mycelium-like, septate, hyaline, later faintly pigmented. Asci 4–10, short-stalked, 30–40 (55) $\times$ (18–) 22–38 μm . Ascospores were not developed.

Distribution in Israel (Fig. 5):

On *Galium aparine* L. – UJ: Qiryat-Tiv'on, Simtat Alivne St., 12.05.2004, S.O. Voytyuk (Voytyuk et al. 2004b).

General distribution: Europe (Austria, Belgium, Bulgaria, Czech Republic, Finland, France, German, Great Britain, Hungary, Italy, the Netherlands, Norway, Poland, Portugal, Romania, European part of Russia, Spain, Switzerland, Sweden, Ukraine), Asia (Afghanistan, China, India, Iran, Israel, Korea).

Notes: Fungus was found in Israel only once. In further investigations, no additional location for this species was found.

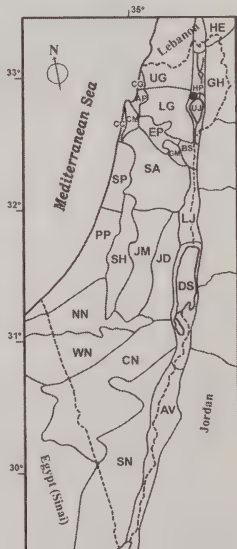


Figure 5: Distribution of *Neoerysiphe galii* in Israel

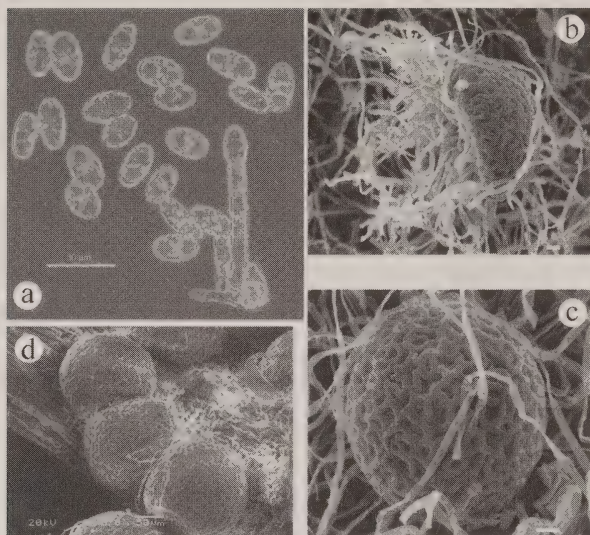


Figure 6: *Neoerysiphe galeopsidis*: a – conidiophore and conidia on *Lamium moschatum*; b, c – chasmothecia on *Prasium majus*; *N. galii*: d – chasmothecia on *Galium aparine*

Conclusions

The results of our investigations have shown that *Neoerysiphe* species are very common in Israel, especially *N. cumminsiana*. Considering the fact that this species is fairly common in the Southern Ukraine and in Israel, we conclude that *N. cumminsiana* is possibly widespread in other Mediterranean countries. Therefore, comprehensive re-examinations of collections on composites from arid regions of Eurasia referred to *Erysiphe cichoracearum* are necessary to point out the genuine host range and distribution of *N. cumminsiana*.

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Characterization of three species of the genus *Coprotus* (Ascomycota) by isozyme analysis

MARÍA EUGENIA SUÁREZ¹, MARÍA ESTHER RANALLI,
DIANA ANA DOKMETZIAN & ARACELI MARCELA RAMOS²

¹ euge@bg.fcen.uba.ar ² araceli@bg.fcen.uba.ar

Depto. Biodiversidad y Biología Experimental, FCEN, Universidad Buenos Aires
Pab. II Ciudad Universitaria, Buenos Aires, C1428EHA, Argentina

Abstract—Identification of *Coprotus* species has never been an easy task. Their morphological and cultural characteristics are very similar and this often makes species delimitation very difficult. In this study we first identified 44 monosporic strains of three species of the genus (*C. lacteus*, *C. niveus*, *C. sexdecimsporus*) by using exclusively morphological and cultural characters; then, an extensive isozyme analysis was performed as an additional taxonomical technique. Eleven isozyme systems were tested. Six of them were chosen for the following analysis. The phenogram (UPGMA) and the 3D graphic (ordination technique) clearly separated the three species. The results of this study support the utilization of isozyme patterns as a valuable additional tool in delimiting *Coprotus* species based on traditional taxonomical methods.

Keywords—fungi, taxonomy, phenetics

Introduction

The genus *Coprotus* Korf ex Korf & Kimbr. comprises homothallic species previously placed in *Ascophanus* Boud. and *Ryparobius* Boud. (Kimbrough 1966, Kimbrough et al. 1972). It was originally placed in the tribe *Theleboleae* (Bref.) Kimbr. (= *Pseudoascoboleae* Boud.) of the *Pezizaceae* Dumort., but in more recent studies the tribe was raised to family rank (Kimbrough & Gibson 1980). Since 1974, when Kish suggested transferring *Coprotus* to *Pyronemataceae* Corda, based on cytological and developmental studies, many other arguments have been found that strongly ratify this movement.

Coprotus includes those species of coprophilous discomycetes with non-amyloid operculate asci containing hyaline, smooth, elliptic ascospores that usually develop one de Bary bubble. Apothecia are small, superficial, sessile, white to bright orange, and pulvinate to discoid in shape. Paraphyses are always septate, simple or branched, and usually curved in the apex. Traditional identification of *Coprotus* species is exclusively based on cytological and

morphological characters, such as the number of ascospores per ascus, the presence or absence of pigments in paraphyses and excipulum, and the size and shape of asci, ascospores and sterile elements. However, difficulties often arise while attempting to identify *Coprotus* species, as they are morphologically very similar and characters frequently overlap.

In the last few decades, there has been a clear tendency towards the utilization of biochemical and molecular characters as a complement to the classic methods of fungal species identification. Morphological, cytological and developmental characters are not always sufficient to allow clear species identification, especially in taxonomical groups with overlapping characters, or simply in polymorphic fungi that change the size, shape and pigmentation of their structures according to the variation of environmental factors.

Isozymes are multiple forms of an enzyme that share a common substrate and catalyse the same reaction (Markert & Moller 1959). They can exist in the same individual or in different individuals of the same species or taxon, and catalyse reactions either in separate cellular compartments or tissues, or in different metabolic conditions (Markert 1975).

Isozyme analysis is one of the most commonly employed techniques to evaluate genetic variation at population and species level. This technique may provide essential data to clarify evolution and taxonomical problems, and it is particularly useful in classifying problematical groups, such as synmorphic species (Ferreira 2000). In the past twenty years, isozyme analysis has been satisfactorily employed to delimit fungal taxa and to identify unknown fungi at species or subspecies level (Micales et al. 1992). Several authors have delineated fungal species using isozymes: *Puccinia* (Burdon et al. 1983, Newton et al. 1985), *Penicillium* (Cruickshank & Pitt 1987), *Rhizopogon* (Ho & Trappe 1987), *Agaricus* (Kerrigan & Ross 1988), *Glomus* (Hepper et al. 1988), *Phytophthora* (Erselius & de Vallavieille 1984, Bielenin et al. 1988, Blaha et al. 1994, McHau & Coffey 1995), *Pleurotus* (Boisselier-Dubayle 1983, May & Royse 1988), *Tremella* (Hanson & Kenneth 1991), *Arthrotrichum* (Araújo et al. 1997), *Ganoderma* (Gottlieb et al. 1998), *Saccobolus* (Ramos et al. 1999, Ramos et al. 2000), *Mucor* (Vagvolgyi et al. 2001), *Fusarium* (Laday & Szecs 2002, Aly et al. 2003), *Polyporus* (Borges da Silveira et al. 2003), *Zygosaccharomyces* (Duarte et al. 2004), and *Ascobolus* (Dokmetzian et al. 2005).

Taking into account the difficulties that frequently arise when identifying *Coprotus* species by traditional methods, as well as the fact that it has been well proved that isozymes are useful for delimiting fungal species, we performed an extensive isozyme analysis to characterize three species of the genus. The particular purposes of this analysis were to establish the degrees of intra- and interspecific similarity and also to evaluate the phenetic relations between strains in order to confirm our previous species identification.

Materials and methods

Monosporic strains

Forty-four monosporic strains of three species of the genus *Coprotus* (*C. lacteus* (Cooke & W. Phillips) Kimbr. et al. (1972), *C. niveus* (Fuckel) Kimbr. et al. (1972) and *C. sexdecimsporus* (P. Crouan & H. Crouan) Kimbr. & Korf (1967) were obtained from individual ascospore germinations, following the procedure indicated by Gamundi & Ranalli (1964). They were all deposited in the BAFC Herbarium & Culture Collection of the Departamento de Biodiversidad y Biología Experimental, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires. Table 1 shows a list of the strains with their geographical location, substrate and BAFC number. Cultures of all of the monosporic strains were regularly kept in PF medium (yeast extract, 3 g; agar 18 g; distilled water, 1000 ml; a slice of filter paper) (Ranalli & Forchiasini 1974) at 5°C.

Table 1. List of strains with their geographical location, substrate and BAFC number.

Strain	Geographical location	Substrate	BAFC	Strain	Geographical location	Substrate	BAFC
<i>Coprotus lacteus</i>				<i>Coprotus niveus</i>			
lacA1	Agronomía	cow dung	874	nivE1	Bahía Ensenada	cow dung	1956
lacA2	Agronomía	cow dung	1936	nivE2	Bahía Ensenada	cow dung	982
lacA3	Agronomía	cow dung	1937	nivE3	Bahía Ensenada	cow dung	1957
lacA4	Agronomía	cow dung	1938	nivE4	Bahía Ensenada	cow dung	1958
lacA5	Agronomía	cow dung	1939	nivE5	Bahía Ensenada	cow dung	1959
lacA6	Agronomía	cow dung	1940	nivC2	Campana	cow dung	1960
lacA10	Agronomía	cow dung	1941	nivC3	Campana	cow dung	1961
lacA13	Agronomía	cow dung	1942	nivC4	Campana	cow dung	1962
lacA14	Agronomía	cow dung	1943	nivC5	Campana	cow dung	1963
lacL1	Villa Lugano	cow dung	1944	nivU1	Ciudad Universitaria	horse dung	1964
lacL3	Villa Lugano	cow dung	1945	nivU3	Ciudad Universitaria	horse dung	1965
lacL4	Villa Lugano	cow dung	1946	nivU6	Ciudad Universitaria	horse dung	1966
lacL6	Villa Lugano	cow dung	1947	nivU7	Ciudad Universitaria	horse dung	1967
<i>Coprotus sexdecimsporus</i>				nivU8	Ciudad Universitaria	horse dung	1968
sexG1	Los Gigantes	cow dung	1948	nivBC1	Bahía Craft	cow dung	1969
sexG2	Los Gigantes	cow dung	873	nivBC2	Bahía Craft	cow dung	1970
sexG3	Los Gigantes	cow dung	1949	nivBC3	Bahía Craft	cow dung	1971
sexG4	Los Gigantes	cow dung	1950	nivBC4	Bahía Craft	cow dung	1972
sexG7	Los Gigantes	cow dung	1951	nivL1	Villa Lugano	cow dung	1973
sexU1	Ciudad Universitaria	horse dung	1952	nivL3	Villa Lugano	cow dung	1974
sexU2	Ciudad Universitaria	horse dung	1953	nivL4	Villa Lugano	cow dung	1975
sexU4	Ciudad Universitaria	horse dung	1954	nivL5	Villa Lugano	cow dung	1976
sexU5	Ciudad Universitaria	horse dung	1955				

Bahía Craft = Villa La Angostura, Neuquén province; *Bahía Ensenada* = Tierra del Fuego province; *Campana* = Buenos Aires province; *Los Gigantes* = Córdoba province. *Agronomía*, *Ciudad Universitaria* and *Villa Lugano* are different locations in Buenos Aires city.

Identification of species

Morphological and cultural studies were carried out in order to identify the species. The former included diverse characteristics of apothecia, ascospores, asci, and paraphyses characteristics, whereas the latter emphasized the time and percentage of NaOH, incubation time at 37°C and the time in ET and solid GA media required for ascospore germination.

The key proposed by Kimbrough et al. (1972) was used for the identification of the species.

Growth media and culture conditions

Erlenmeyer flasks containing 50 ml of liquid growth medium GA (glucose, 10 g; asparagine, 4 g; $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, 0.5 g; KH_2PO_4 , 0.5 g; K_2HPO_4 , 0.6 g; $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, 0.4 mg; $\text{MnCl}_4\text{H}_2\text{O}$, 0.09 mg; H_3BO_3 , 0.07 mg; $\text{NaMoO}_4 \cdot 2\text{H}_2\text{O}$, 0.02 mg; FeCl_3 , 1 mg; ZnCl_2 , 10 mg; biotine, 5 µg; thiamine-HCl 0.1 mg; bidistilled water to complete 1 litre) (Galvagno 1976), were inoculated with a 5 mm² squares taken from a 5 to 10-day-old colony of monosporic strains growing in solid GA medium (glucose, 10 g; agar, 18-20 g; L-asparagine, 1.35 g, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, 0.5 g; KH_2PO_4 , 0.5 g; K_2HPO_4 , 0.6 g; $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, 0.4 mg; $\text{MnCl}_4\text{H}_2\text{O}$, 0.09 mg; H_3BO_3 , 0.07 mg; $\text{NaMoO}_4 \cdot 2\text{H}_2\text{O}$, 0.02 mg; FeCl_3 , 1 mg; ZnCl_2 , 10 mg; biotine, 5 µg; thiamine-HCl 0.1 mg; bidistilled water to complete 1 litre) (Galvagno 1976).

Liquid and solid cultures were both incubated in a New Brunswick Psicrotherm G-27 chamber, at 23°C, permanently lit by four fluorescent tubes of 20 W each; liquid cultures were placed in a rotary shaker at 125 rpm during incubation.

Growth media were sterilized at 121°C and 1.2 atm for 20 minutes.

Preparation of extracts

Mycelia were harvested from liquid cultures one to two days before they reached maximum growth, which was established by growth curves previously charted for each species.

Mycelia were vacuum filtered in a Buchner funnel, through Whatman GP filter paper, washed several times with bi-distilled water, dried with filter paper and stored at -70°C until used (Dessauer et al. 1984).

Extracts were prepared by freezing the mycelia with liquid nitrogen and crushing it several times in a steel mortar, and crushing it once again adding extraction buffer (0.1 M Tris-HCl buffer, pH 7.5); 0.1% v/v 2-mercaptoethanol; 0.001 M ethylenediaminetetraacetic acid (EDTA); 0.01 M KCl; 0.01 M $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$; 10% p/v polyvinyl pyrrolidone (PVP) 10.000 (Soltis et al., 1983). Homogenates were divided into small fractions and stored at -70°C (Dessauer et al. 1984).

Electrophoresis and enzymatic dying

A horizontal electrophoresis technique (Beckman & Johnson 1964) was performed to test eleven isozyme systems. Native gels were prepared using a 7% concentration of polyacrylamide (Saidman 1985). Table 2 shows a list of the eleven isozyme systems tested with their abbreviation and EC number as stated in IUPAC-IUB, Enzyme Nomenclature (1984).

Buffer solutions (gel buffer (a) and electrode buffer (b)) varied according to the specific isozyme system tested. Buffer: (a) Lithium borate pH 8.1 and (b) Lithium borate pH 8.5 (Scandalios 1969, modified by Saidman 1985) was used for AAT, EST and SOD; Buffer: (a) Tris-citrate pH 6.5 and (b) Tris-citrate pH 7 (Selander et al. 1971, modified by Saidman 1985) was employed for ACP, ALP, G6PD, GDH and IDH; and Buffer: (a) and (b) Tris-citrate pH 8 (Soltis et al. 1983) was chosen for the LAP, MDH and SKD systems.

Rectangles of 2 x 4 mm of Whatman N°3 paper were soaked in the protein extracts after thawing the samples, and were introduced into grooves made in the gel (20 per gel). Bromophenol-blue (4 mg/ml) was used as dye marker. Electrophoreses were carried out at 4°C and 100 volts for three to four hours, until the dye marker was at 3-4 cm from the end of the gel.

Staining procedures were performed according to Manchenko (1994) for ACP, ALP, G6PD, IDH and SKD; Soltis et al. (1983) for LAP; Wendel & Weeden (1989) for EST, GDH, MDH and SOD; and Vallejos (1983) for AAT. Once stained, gels were photographed and fixed with a solution of ethanol/ water/ acetic acid (5: 5: 1). Gels were finally transferred to a plastic bag, heat-sealed and kept at room temperature.

The relative position (Rf) of each band of enzymatic activity was determined as the ratio between the migration distance of each band from origin and the migration distance of the dye marker from origin.

Electrophoresis was repeated at least twice for every isozyme system for each strain. Electromorphs were drawn with the average Rf for each band.

Table 2. Isozyme systems tested, their abbreviation and EC number

Isozyme system	Abbreviation	EC number
Aspartate aminotransferase	AAT	2.6.1.1
Acid phosphatase	ACP	3.1.3.2
Alkaline phosphatase	ALP	3.1.3.1
Esterases	EST	3.1.1...
Glucose-6-phosphate dehydrogenase	G6PD	1.1.1.49
Glutamate dehydrogenase	GDH	1.4.1.3
Isocitrate dehydrogenase (NADP)	IDH	1.1.1.42
Leucine aminopeptidase	LAP	1.4.1.9
Malate dehydrogenase (NAD)	MDH	1.1.1.37
Shikimate dehydrogenase	SKD	1.1.1.25
Superoxide dismutase	SOD	1.15.1.1

Numerical analysis

Statistical analyses were performed using the NTSYS-PC version 1.8 program (Rohlf 1993). The nine geographical groups of strains (groups of strains of the same species from the same geographical location) constituted the operative taxonomic units (OTUs), as no isoenzymatic differences were found between monosporic strains from the same geographical location.

Table 3. Morphological and cultural characters of the three *Coprotus* species

Character / Species	<i>C. lacteus</i>	<i>C. sexdecimsporus</i>	<i>C. niveus</i>
1. Apothecia			
Type of growth in the substrate	Solitary or gregarious	Solitary or gregarious	Solitary or gregarious
Colour when young	Translucid to white	Translucid to whitish	White or translucid
Colour when mature	Yellowish	Yellow to orange	Slightly yellowish
Form	Discoid to cupulate	Pulvinate	Discoid to cupulate
Diameter (μm)	200-500	500-1000	200-500
Other characteristics	Superficial, sessile, glabrous	Superficial, sessile, glabrous	Superficial, sessile, glabrous
2. Apothecial excipulum			
Texture	Angularis to globulosa	Globulosa	Globulosa to angularis
Staining	Cyanophilous and dextrinoid	Dextrinoid	Slightly cyanophilous
3. Asci			
Length (μm)	65-85	106-123	86-164
Width (μm)	15-20	23-28	29-41
Form	Clavate cylindrical	Clavate	Broadly clavate
Number of spores	8	16	64
Apex	Round or cupulate, central operculum	Round or cupulate, central operculum	Round, with a prominent central operculum
4. Ascospores			
Length (μm)	9.5-11	11.7-12.35	9.1-12.7
Width (μm)	5.8-6.5	7.8-9.1	5.9-7.3
Form	Elliptical	Elliptical	Elliptical
Colour	Hyaline	Hyaline	Hyaline
Exosporium	Smooth	Smooth	Smooth
Arrangement within the asci	Uniseriate or biseriate	Regularly biseriate, sometimes in threes in the apex	Irregularly arranged in the apical portion or occupying all the volume in small asci
5. Paraphyses			
Diameter (μm)	1.5-2	1.7-2.6	1.8-2.7
Form	Filamentous	Club	Filamentous
Branching	Simple or branched	Simple or bifurcated below	Simple or branched
Apex	Curved	Hooked	Curved
Other characteristics	Septate, slightly inflated	Hyaline, septate	Septate, hyaline, without oil droplets
6. Ascospore germination			
Optimum NaOH %	0.3	0.3	0.4
Treatment time with NaOH	30 minutes	30 minutes	20 minutes
Incubation time at 37°C	48-72 hours	48 hours	48 hours
7. Culture			
Mature fructifications in ET media	15 days	15-16 days	15 days
Mature fructifications in GA media	10 days	15-16 days	12 days

A data matrix was constructed by coding the presence (1) and absence (0) of bands (characters). A similarity matrix was then obtained by using the Simple Matching Coefficient (Sneath & Sokal 1973). Both a clustering method (Unweighted pair-group method using arithmetic averages, UPGMA) and an ordination technique (Principal Coordinates) were performed. With the former method, a phenogram was obtained, and the distortion produced during the grouping analysis was calculated with the cophenetic correlation coefficient (r) (Sokal & Rohlf 1962). A three-dimensional graphic was obtained with the ordination method.

Results

Morphological and cultural studies

Table 3 gives the morphological characters and cultural aspects observed for each *Coprotus* species. Overlapping of several qualitative and quantitative characters can be clearly seen in this table. For this reason, in many cases considerable difficulty was experienced in identifying the strains. A greater similarity between *C. lacteus* and *C. niveus* was observed.

Isozyme analysis

Only six of the eleven systems tested showed a good activity band resolution for every strain: AAT, ALP, EST, G6PD, IDH and SOD. The remaining systems (ACP, GDH, LAP, MDH and SKD) showed poor resolution, or none at all, and were therefore excluded from the following statistical analyses.

No isoenzymatic differences were found between strains from the same geographical location, and only EST revealed differences between geographical groups of the same species, thus proving the existence of a high intraspecific similarity.

Seventeen electromorphs were detected for the six systems chosen. Photographs of gels and zymograms of each electrophoretical phenotype are shown in Figures 1 and 2.

Two electromorphs were found for the AAT, IDH and SOD systems. In each case, all geographical groups of *Coprotus lacteus* and *C. niveus* shared an electromorph (A), while the two geographical groups of *C. sexdecimsporus* displayed a different pattern (B). Only one activity-band characterized the two electromorphs of AAT and IDH, while four bands were revealed in the two patterns found for SOD.

The ALP system was the only one that revealed a diagnostic pattern for each species (A-C), the three of them with only one band of enzymatic activity.

The G6PD system did not show differences between geographical groups or between species. Only one electromorph was found, with one band of Rf 16.

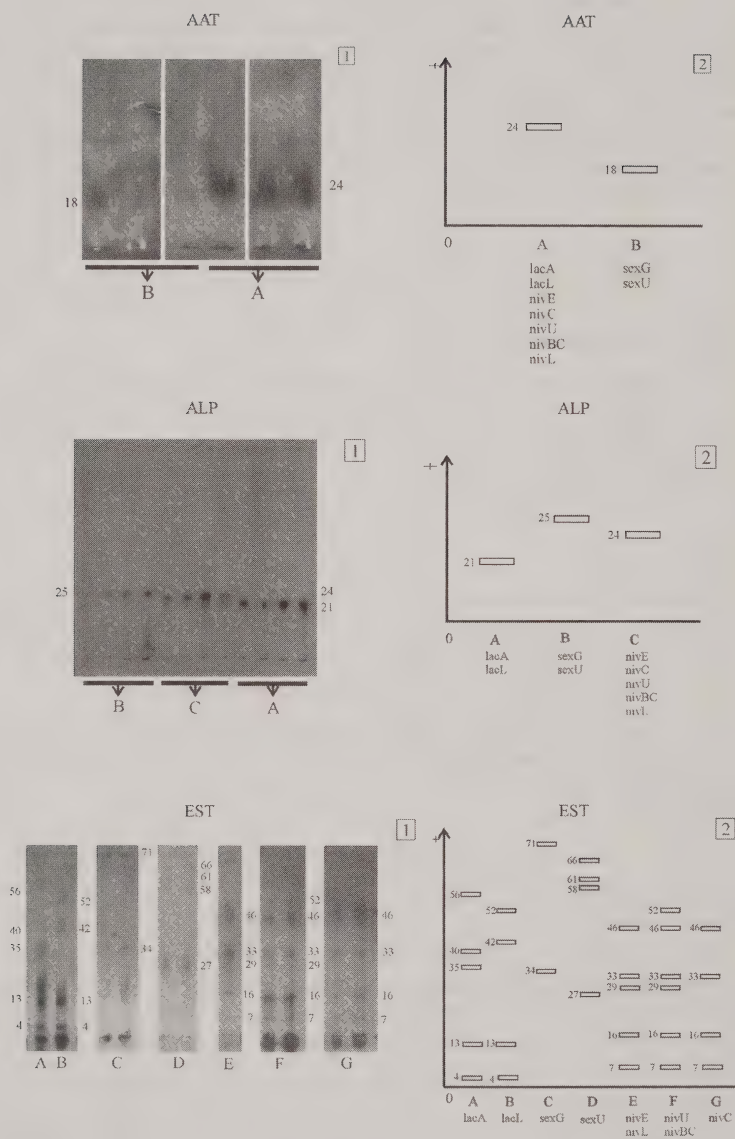


Figure 1. Gels photographs (1) and zymograms (2) of each electrophoretic phenotype found for AAT, ALP and EST isozyme systems. The geographical groups corresponding to each electromorph are indicated in (2).

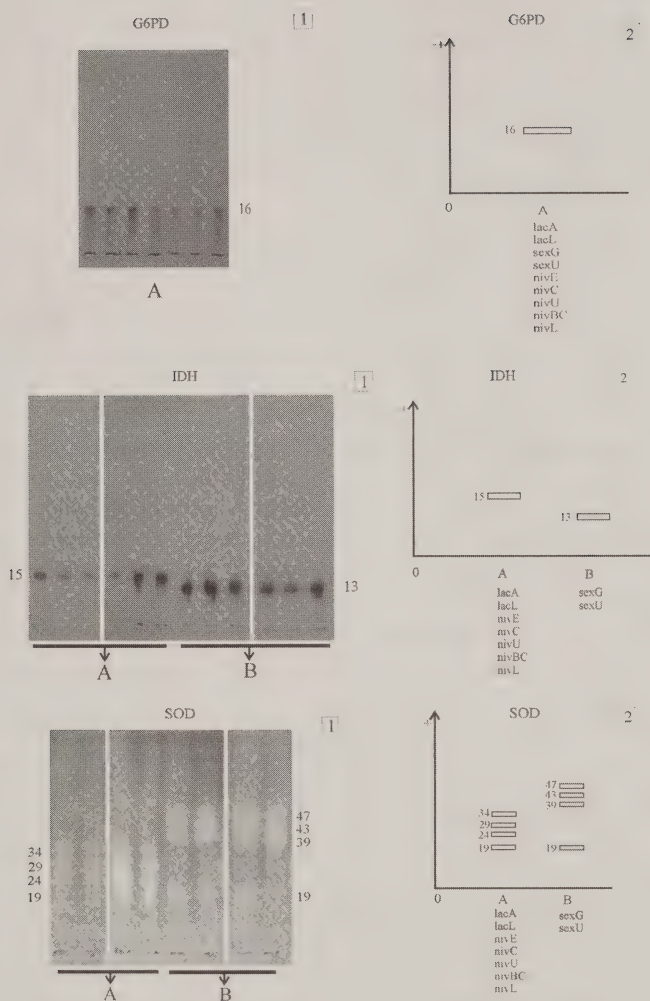


Figure 2. Gels photographs (1) and zymograms (2) of each electrophoretic phenotype found for G6PD, IDH and SOD isozyme systems. The geographical groups corresponding to each electromorph are indicated in (2).

On the contrary, EST was the system that revealed the greatest number of activity-bands and also the only one that allowed us to distinguish between geographical groups of the same species. The two geographical groups of *C. lacteus*, as well as the two of *C. sexdecimsporus*, showed a characteristic band pattern for EST (patterns A to D). The strains of *C. niveus* from Bahía Ensenada and Villa Lugano displayed another band pattern (E), and the same happened with those from Ciudad Universitaria and Bahía Craft, characterized by another electromorph (F). The group of strains from Campana revealed the seventh pattern (G) found for esterases for this species.

The phenogram obtained using the UPGMA clustering method is shown in Figure 3. Little distortion occurred while constructing this dendrogram, as implied by the value of the cophenetic correlation index ($r=0.992$). The three species are clearly separated in the phenogram. Apart from that, two main clusters of OTUs are distinctly seen: one of them covers the two geographical groups of *C. sexdecimsporus* with a similarity index of 80%, while the other includes all of the geographical groups of *C. niveus* and *C. lacteus*. This result reveals a higher isoenzymatic resemblance between these two species, which are associated by an index of 63%. The group of *C. sexdecimsporus* strains is associated to the other species by a remarkably low degree of similarity (33%). All the geographical groups corresponding to *C. niveus* proved to be practically identical, as in the phenogram they are related by a similarity index of 95%. The geographical groups of *C. lacteus* are associated to each other by an index of 84%, evidence of further isoenzymatic differences.

The three-dimensional graphic produced by the ordination technique (Figure 4) shows the same relations between different geographical groups and between species as the phenogram. It displays three main sets of OTUs separated in axes 1 and 2. The first one includes the two geographical groups of *Coprotus lacteus*, a little differentiated in axis 1 but very closely attached in the other two axes. The second set shows the five geographical groups of *C. niveus* joined closely together in the three axes, thus revealing a high degree of similarity. The third and last main set of OTUs comprises the two geographical groups of *C. sexdecimsporus*, which are very close to each other in axes 1 and 2, but are largely separated in axis 3. The differences among species as a unit also agree with the associations obtained with the phenogram: *C. lacteus* and *C. niveus* separate from each other in axes 1 and 2, but in axis 3 they are practically at the same level. *C. sexdecimsporus* separates itself from the other two species in the three axes, thus proving a higher isoenzymatic differentiation.

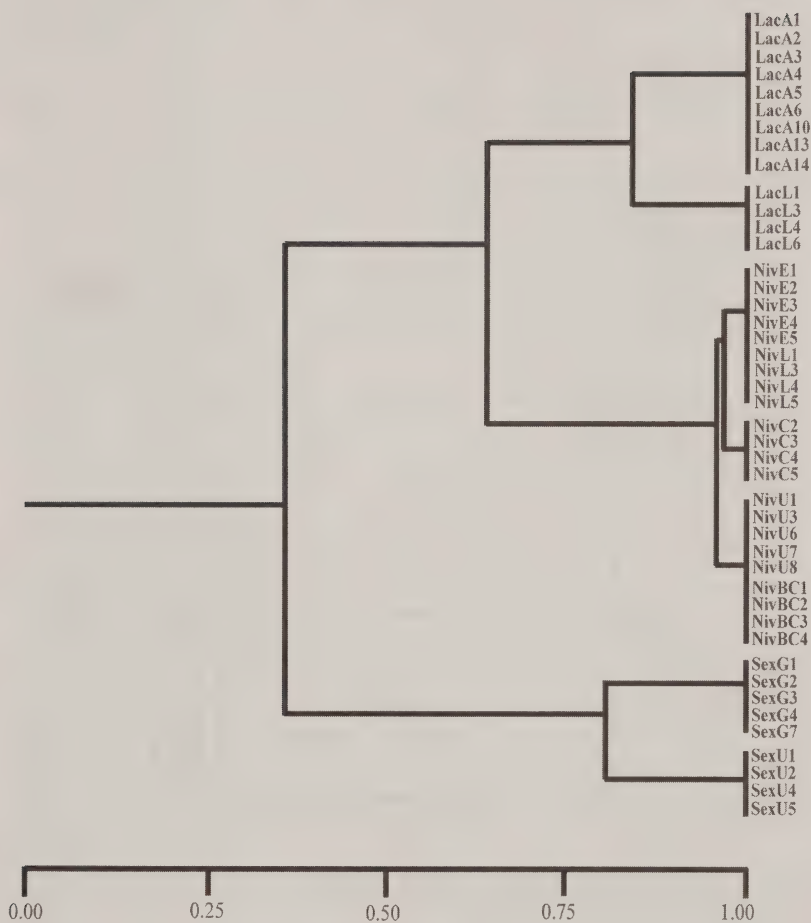


Figure 3. Phenogram obtained using UPGMA clustering method. For details on the strains, see Table 1.

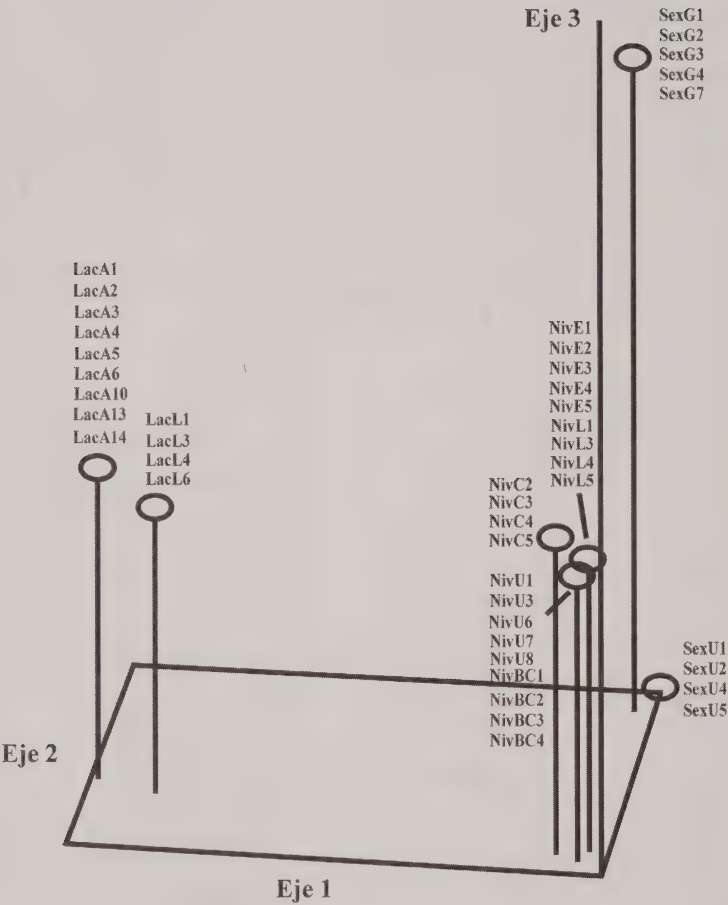


Figure 4. Three-dimensional graphic obtained with Principal Coordinates ordination technique.
For details on the strains see Table 1.

Discussion

Although identification of the species was possible, morphological and cultural characterization of the strains proved the high similarity and coincidences in many of the characters traditionally used for identifying *Coprotus* species. Harrington & Rizzo (1999) suggest that the most important diagnostic characters to delineate fungal species would be those phenotypic characters

associated with the ecological niche, as they would play a decisive role in developing and maintaining fungal species through evolution. Hence, species should be delineated considering not only morphological but also other phenotypic characters, such as physiological and biochemical characteristics, including isozymes.

Another interesting result from cultural and morphological observations is that both qualitative and quantitative characters show that *C. lacteus* is more similar to *C. niveus* than to *C. sexdecimsporus*.

The isoenzymatic results confirmed the previous identification of the strains using morphological and cultural characters. Both the phenogram and the ordination graphic showed the same three clearly separated clusters of OTUs (geographical groups), each of them corresponding to one of the three species. The phenogram also showed that there is a greater isoenzymatic resemblance between *C. lacteus* and *C. niveus*, and this result is consistent with previous morphological observations.

The scarce intraspecific variability encountered during isozyme analysis highlighted interspecific differences. This was crucial for our work, because when high intraspecific variability exists it overshadows the differences between species, thus reducing the efficiency of the technique used to separate them. Studies using enzymes that detect high levels of intraspecific variability are incapable of distinguishing species (Racine & Langley 1980). Different types of enzymes show different levels of intraspecific variation according to the selection forces they are subjected to (Johnson 1974). Regulatory enzymes of the energetic metabolism, and even the enzymes that regulate the intermediate metabolism, generally evidence a lower variability than non-regulatory enzymes such as esterases. Despite the slight overestimation of the differences they may cause between OTUs, isozyme systems that generally reveal intraspecific variability, such as EST, are also crucial in achieving correct species characterization. Both types of enzymes (regulatory and non-regulatory) are therefore necessary to prevent overestimation and underestimation of isozyme variability within and between populations.

ALP was the only system that showed a diagnostic electromorph for each species. Hence, this was the most useful system in confirming our previous species identification. In any study that uses isozymes to identify species this is the expected kind of result, as they reveal a clear and easy species distinction.

The existence of band patterns shared by two or more species is consistent with the high overlapping in morphological characters associated with them. In addition, the fact that only one band for each species in the majority of the systems analyzed was obtained is in accordance with the fact that *Coprotus* species are haploid fungi with only one locus per enzyme (Ramos 1998).

The generally low intraspecific variability found may be related to habitat and the type of sexual reproduction of the *Coprotus* species. They are homothallic organisms, which is not unusual among coprophilous fungi. As they live in pieces of dung (island substrate), they undergo reproductive isolation. In these cases, homothallism allows them to complete their biological cycle and to reproduce sexually without requiring another thallus. Mutations are the principal source of genetic variation in a haploid homothallic organism, which explains the relatively scarce isoenzymatic variability found in this study. The correlation between the degree of enzymatic variability and the type of reproduction and the habitat of organisms has been studied by several authors in recent decades. Burdon et al. (1983) found that there was no isoenzymatic variability in *Puccinia graminis* f. sp. *tritici* when it reproduces asexually. The same behaviour was observed in *Phakopsora pachyrhizi* (Bonde et al. 1988) and *Puccinia striiformis* (Newton et al. 1985), both pathogens that do not reproduce sexually. Harrington et al. (1996) observed very low isoenzymatic variability in homothallic *Ceratocystis* species and a much higher variability in those heterothallic species of the genus. Ramos (1998) worked with *Saccobolus* species, homothallic coprophilous fungi, also obtaining low isoenzymatic variability. This was the case for Dokmetzian (1999) while working with *Ascobolus*: as these are heterothallic and coprophilous fungi, the low variability may be due in this particular case to homogeneous environmental conditions rather than to the type of reproduction. In a heterogeneous environment, the optimum evolutionary strategy for enzymes would be the existence of multiple forms of the enzyme, rather than only one alternative with high capacity (Johnson 1974). Heterogeneity of enzymes provides organisms with metabolic versatility, thus generating a higher biological efficiency in heterogeneous environments (Zeidler 2000). As regards coprophilous environments, which are often quite homogeneous, it would seem that coprophilous fungi do not require a high isoenzymatic variability to survive. However, the dung microhabitat is slightly conditioned by climatic factors, plant cover and soil properties, which determine the temperature and humidity of the substrate, factors that in turn indirectly influence metabolic activities and the competitive capacity of organisms (Wicklow 1981). Therefore, having different isozyme systems, at least in non-regulatory systems (such as EST), is always a benefit for these fungi.

Principal Coordinates analysis revealed the same groupings as the phenogram and even the same intraspecific differences. This provides much greater reliability in the relationships among species and among populations found in this study.

Considering that isozyme characterization of the three *Coprotus* species allowed us to clearly identify each geographical population and each species, and that it confirmed our previous identification, this technique may be considered

an important additional tool to the traditional taxonomic methods, particularly in problematical groups as *Coprotus*, in which overlapping of characters and high interspecific similarity usually make species identification difficult.

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Schadonia indica, a new corticolous species from tropical India

D.K. UPRETI* & S. NAYAKA

*upretidk@rediffmail.com

Lichenology Laboratory, National Botanical Research Institute
Rana Pratap Marg Lucknow – 226 001, India

Abstract—*Schadonia indica* is described as new to science. It is a corticolous species, with *Bacidia*-type, eight-spored asci, ellipsoidal to ovoid, hyaline, muriform ascospores, occurring in the tropical region.

Key words—*Bacidiaceae*, crustose lichen

Introduction

The genus *Schadonia* is characterized by having crustose thallus, lecidiioid apothecia with dark hypothecium, thin, branched and anastomosed paraphyses, cylindrical-clavate, *Bacidia*-type, 2–8 spored asci with strongly I+ blue tholus, and hyaline, muriform ascospores. It superficially similar to *Lopadium* with respect to lecidiioid apothecia, hyaline, muriform ascospore and hence there is a chance for confusion between the two genera. However, *Lopadium* differs in having simple paraphyses with dark brown conical caps and single-spored asci that lack distinct apical dome (Purvis et al. 1992). The new species *Schadonia indica* is the first representation of this genus from the country. All the other species of *Schadonia* described elsewhere from the world are reported to grow on mosses in temperate to alpine regions, whereas *S. indica* was found growing in tropical regions of central India, at the base of mature *Shorea robusta* trees together with mosses.

Materials and methods

Specimens were examined morphologically, anatomically and chemically. Thin hand sections of apothecia and thalli were mounted in plain water, cotton blue, 5% KOH, or iodine solution and observed under a compound microscope. For chemical spot reaction the usual reagents of K, C and PD were used. TLC was performed in solvent system A following Walker & James (1990).

Schadonia indica Upreti & Nayaka sp. nov.

Fig. 1-5

MYCOBANK #: MB 510306

Thallus corticolous, crustaceus, granulosus vel coralloideus, viridulo-fuscus, continuus, haud limitatus, ecorticatus, cellulis algarum chlorococcoideis, prothallo nullo instructus. Apothecia dispersa, sessilia, basim constricta, orbicularia, 0.5–1.2 mm lata; discus fuscus vel badiofuscus, planus demum concavus vel raro convexus, epruinosis; marginibus distinctis, concoloris disco vel paulum pallidioris. Excipulum lecidinum, hyphis radiantibus, cellulis ± isodiametricis, pseudoparenchymaticis, K–; epihymenium luteolum vel brunneolum, K–; hymenium hyalinum, 70–80 µm crassum, I+ caeruleum; subhymenium hyalinum, 40–45 µm crassum, I+ caeruleum; hypothecium fuscum, K–. Asci 8-spore, clavati, 40–45 µm longi, 6–8(–10) µm lati, tholus I+ caeruleus, typo “Bacidia” dicto. Ascospores hyalinae, muriformae, ellipsoideae vel ovoideae, 14–17 x 4–7 µm. Paraphyses ramosi et anastomosi.

Etymology: From India, the country from where the first collection is described.

Holotypus: INDIA, Madhya Pradesh, Dinodri district, 8 km before Kabir from Chauradadar, 650 m, 06-07-2005, Upreti, Nayaka & Satya 05-005712/A (LWG–holotype).

Thallus corticolous, crustose, scurfy, granular to coralloid, greenish brown, continuous, not delimited; ecorticate, photobiont chlorococcoid; prothallus absent.

Ascomata apothecia, scattered, sessile, constricted at base, roundish, 0.5–1.2 mm in diam.; disc brown to dark brown, plane to concave or rarely convex, epruinose; margin prominent, thick, concolorous with the disc or slightly paler. Exciple in section lecidine, darker towards base and inner side; hyphae radially oriented; cells more or less isodiametric, pseudoparenchymatous, K–; epihymenium yellowish to brownish, K–; hymenium hyaline, 75–80 µm high, I+ blue; subhymenium hyaline, 40–45 µm, I+ blue; hypothecium pale to dark brown, K–. Asci 8 spored, clavate, 40–55 x 10–22 µm; tholus I+ blue, *Bacidia*-type; ascospores hyaline, muriform, with 6–8(10) transverse septa, 1–2 vertical septa, with 15–20 cells arranged in 5–6 tiers, 14–17 x 4–7 µm, ellipsoid to ovoid; immature spores sometimes only transversely septate; paraphyses branched and anastomosed, thin, apical cell slightly swollen (in K).

Chemistry: K+ red, C–, KC+ red, P–. No lichen substances in TLC.

Distribution and ecology: All the three recognized species of *Schadonia* (*S. alpina* Körb., *S. fecunda* (Th. Fr.) Vězda & Poelt, and *S. subobscurata* (Vain.) Kalb.) are temperate species and growing over mosses. However, *S. indica* is a corticolous species growing luxuriantly on the bark of old *Shorea robusta* among mosses on trees at altitudes of 500–700 m.

Remarks: *Schadonia indica* is characterized by a corticolous, scurfy, granular thallus, brown apothecia, and ellipsoid to ovoid, muriform ascospores. It is close to *S. fecunda* with respect to thallus morphology, ascus and ascospore characters. However, *S. fecunda* differs in having black apothecia, a K+

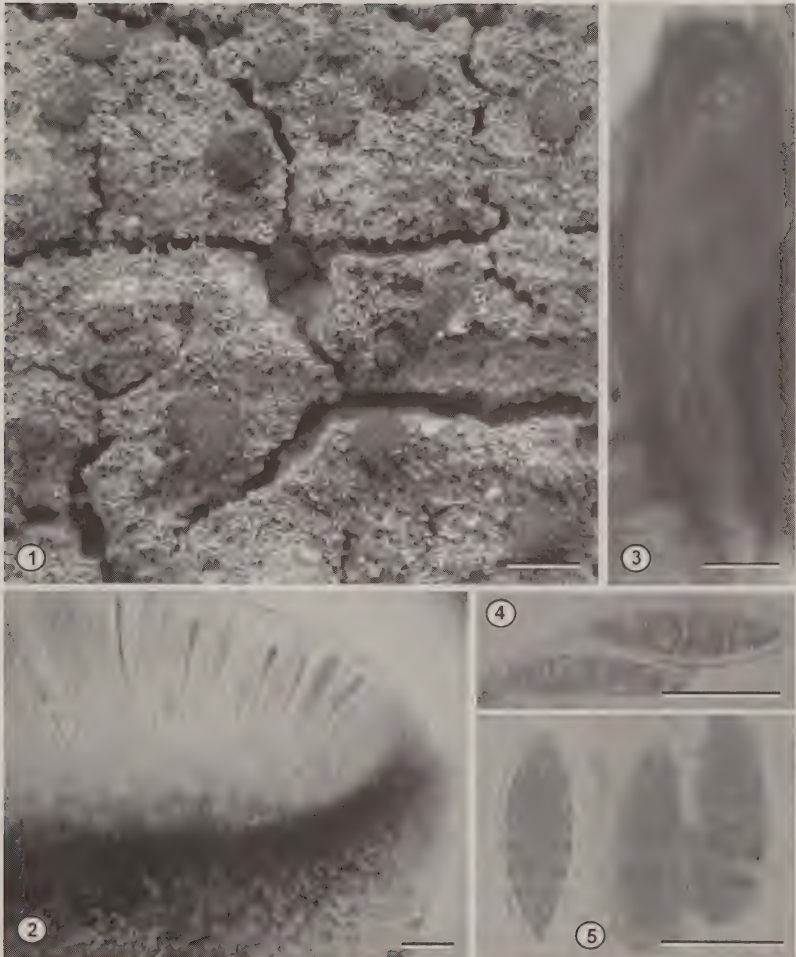


Figure-1-5. *Schadonia indica* sp. nov. (holotype)

1. Habit; 2. L.S. of apothecia;

3. Ascus with spores and I+ blue tholus;

4. Immature ascospores with vertical septa; 5. Mature ascospores.

(Bars, Fig. 1 = 2 mm, 2 = 20 μ m, 3,4&5 = 10 μ m)

purplish-brown epihymenium and a K+ deep red-brown hymenium (Purvis et al. 1992).

ADDITIONAL SPECIMENS EXAMINED-MADHYA PRADESH: Dinodri district, 8 km before Kabir from Chauradadar, 650 m, 06-07-2005, Upreti, Nayaka & Satya 05-005706 (LWG); near Kabir, 600 m, 08-07-2005, Upreti, Nayaka & Satya 05-005807 (LWG).

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Phylacia mexicana sp. nov. and consideration of other species with emphasis on Mexico

ROSARIO MEDEL¹, JACK D. ROGERS² & GASTÓN GUZMÁN¹,

¹*rosario.medel@inecol.edu.mx & gaston.guzman@inecol.edu.mx*

Instituto de Ecología, Unidad de Micología

Apartado Postal 63, Xalapa, 91000, Veracruz, Mexico

²*rogers@wsu.edu*

Department of Plant Pathology, Washington State University

Pullman, Washington 99164-6430, USA

Abstract—The known species of *Phylacia* in Mexico are discussed. *Phylacia mexicana* is described as a new species from the states of Chiapas and Veracruz. A key to the known species is included. The affinities among *Phylacia* and other genera are considered.

Key words—Ascomycotina, *Xylariaceae*, *Phylaciaceae*, *Pulveria*

Introduction

Phylacia is a genus of large cleistocarpous pyrenomycetes of uncertain affinities. The genus is found mostly (perhaps entirely) in the American tropics. Dennis (1957) discussed and depicted six species and Speer (1980) described an additional two species. Rodrigues & Samuels (1989) described a large-spored variety of *P. bomba* Patouillard (1913) described *P. pusilla* Pat. from Asia; Hawksworth (1977) did not consider this to be a *Phylacia*.

In Mexico, only one study has been conducted on *Phylacia* (Pérez-Silva 1972), along with some isolated references that cite species from certain parts of the country (Welden & Guzman 1978, Varela & Cifuentes 1979, Díaz-Barriga et al. 1988). The objective of the present study is to examine *Phylacia*, principally in Mexico, and to describe *P. mexicana* as a new species. Material from other regions was also reviewed and new records are noted from the Bahamas, Belize, and Cuba. A key to described species is presented.

Materials and methods

Preparations in, 5% KOH, cotton blue, and Melzer's solution were employed to enhance microscopic examination. All material studied is deposited in the

Fungi Collection of the Herbarium of the Instituto de Ecología (XAL). Some are duplicates from the following herbaria: Escuela Nacional de Ciencias Biológicas (ENCB), Universidad de Guadalajara (IBUG), Universidad Autónoma Metropolitana (UAMIZ), and the personal herbarium of M.A. Vincent. Furthermore, the *P. turbinata* type from the Royal Botanical Gardens (K) was examined. Scanning electron micrographs were taken of the ascospores of most of the species studied.

The genus *Phylacia*

Phylacia Lév., Ann. Sci. Nat. Bot. Sér. 3, 3: 61. 1845.

Stromata solitary or gregarious, lignicolous, cleistocarpous, hemispherical, globose, pyriform, clavate or turbinate, apex rounded, sunken, or flattened, the interior of the upper parts composed of elongated tubular chambers in which asci are produced, disintegrating with age and leaving the mass of ascospores exposed. Stromata carbonaceous, dark brown to black, sessile or stipitate, 2-17 mm diameter, with surface rough or with slight ridges that create a rough appearance especially near the base, or with surface smooth. Asci globose, lacking stipe and apical apparatus, disintegrating with age, originating directly from the geniculated ascogenous hypha. Ascospores oblong-ellipsoid, ellipsoid, fusoid with rounded or somewhat tapered ends, yellowish, olive, olive-brown, or pale brown, lacking germ slits or perhaps easily discernible slits, with thin or thick wall; those of some species reaching a thickness of up to 1 μm . Paraphyses filiform, hyaline, abundant, with or apparently without septa.

Anamorph: *Geniculosporium* Chesters & Greenh. (Rodrigues & Samuels 1989).

Distribution: Tropical America. One species reported from Asia.

Phylacia species known in Mexico

Phylacia bomba (Mont.) Pat., in Duss, Énum. Champ. Guadeloupe: 74. 1903.

FIG. 1

The stromata are hemispherical to pulvinate and sessile in this species, along with ascospores (10–13 x 5–7 μm) fide Dennis (1957, 1971) and Rodrigues & Samuels (1989). According to the material cited here, the diameter of stromata reaches up to 9 mm broad. Our observations suggest that this is the only species of the genus without a conspicuous entostroma. In Mexico, the species has only been previously reported from Veracruz (Pérez-Silva 1972).

Distribution: The Bahamas, Cuba, Mexico, Venezuela.

Specimens examined—THE BAHAMAS. ANDROS ISLAND, on dead upright wood of *Exothia paniculata*, 22-V-1988, Vincent 2796 (XAL).—MEXICO. COLIMA, Archipelago

Revillagigedo, Isla Socorro, *Ficus* and *Psidium* forest, on *Zantoxylum insulare*, 19-IV-1995, Gomez 876 (XAL). TABASCO, municipality of Huimanguillo, Colegio Superior de Agricultura Tropical, cocoa plantation, 14-IX-1982, Rodriguez 890 (UAMIZ, dupl. XAL). QUINTANA ROO, trail to the sea from the Puerto Morelos-Tulum highway after the turn-off to Vallarta, disturbed tropical deciduous forest, 10-XI-1981, López 1795, 1796 (XAL), 15 km from Coba, highway to Xcan, disturbed deciduous forest, 12-XI-1981, López 1915 (XAL). VERACRUZ, Catemaco-Las Margaritas, Tebanca, 3 km from Coyame, pasture with tropical trees, 2-XI-1982, Chacon 867 (XAL), Los Tuxtlas region, near the UNAM Biological Station, 30-I-1988, Chacon 4035 (XAL), road to Montepío; Botanical Garden of the UNAM Biological Station tropical vegetation, 26-VII-1981, Guzman 19841 (ENCB, XAL); municipality of Catemaco, Cerro El Marinero, Ejido López Mateos, evergreen forest, 28-VI-1987, Mata 178 (XAL); Cordoba region, municipality of Ixtaczoquitlán, Metlac Bridge, montane rain forest, 28-IX-1996, Tapia 1540, Huatusco-Maromilla highway near Puentequilla, 23-VIII-1984, Chacón 2366 (XAL); municipality of Las Choapas, 'El Milagro' Ranch, 5 km SW of Nueva Tabasqueña, 9-XII-2005, R. Medel 1191, 1194, 1201 (XAL).

Phylacia bomba var. *macrospora* K.F. Rodrigues & Samuels, Mem. New York Botanical Garden. 49: 293. 1989.

The larger ascospores 13.5–15.5 (–16.2) x 5.4–7 (–7.2) μm distinguish this variety from the type variety. The ascospores of the studied material were up to 7.2 μm wide. *Phylacia bomba* var. *macrospora* has not previously been recorded in Mexico.

Distribution: Guyana, Mexico.

Specimens examined—MEXICO. JALISCO, municipality of Casimiro Castillo, Autlán-Malacah highway, 20 km from Autlán, El Tigre, montane rain forest, 6-I-1985, Fanti 468 (IBUG, dupl. XAL); VERACRUZ, Ixtaczoquitlán municipality, near Metlac ravine, 11.IX-1994, Navarro 593 (XAL).

Phylacia globosa Lév., Ann. Sci. Nat. Bot. Ser. 3, 3: 61. 1845.

FIGS. 2, 9

Stromata subglobose, sometimes pyriform, stipitate, (Dennis 1957, 1971; Rodrigues & Samuels 1989). In all the material examined the stromata were 4–6 (–10) mm diameter, smaller than the range 8–15 mm, reported by Rodrigues & Samuels 1989, spores size 9–15 x 5–7.5 (–8.5) μm . It is known in the Mexican states of Chiapas, Nuevo Leon, Puebla, Quintana Roo (Pérez-Silva 1972) and Veracruz (Welden & Guzmán 1978).

Distribution: Argentina, Brazil, Columbia, Guadalupe, Mexico, Venezuela.

Specimens examined—MEXICO. CHIAPAS, municipality of Ocozocauhtla, El Ocote Ecological Reserve, disturbed evergreen forest, 14-II-1986, Carrión 795 (XAL), municipality of Palenque, Michol-Ha Waterfalls, high deciduous forest, 22-XII-1985, Chacón 3304 (XAL). Hidalgo, Km. 237 Tamanzunchale-Jacala highway, intersection with Miraflores, montane rain forest, 14-VIII-1980, Valenzuela 290 (ENCB, XAL). QUINTANA ROO, Puerto Morelos, CIQRO Botanical Garden, disturbed tropical

forest, 13-XI-1983, Escalante 191 (XAL); Puerto Morelos, semideciduous forest, 6-III-1990, Ancona 77 (XAL): VERACRUZ, between the Zacoapan and El Mirador, 5-V-1982, Brown 388 (XAL); municipality of Actopan, El Morro de la Mancha Ecological Reserve (CICOLMA) 19-V-1994, Rico 192 (XAL); municipality of Catemaco, Los Tuxtlas region, Santa Martha Road toward Bastonal, tropical forest, 9-III-1997, Mata 123 (XAL); between Catemaco and Sontecomapan, coffee plantation, 11-VII-1978, Guzmán 17146 (XAL); municipality of Coatepec, La Orduña, coffee plantation, 15-X-1983 Villarreal 975 (XAL); municipality of Coatepec, El Grande, coffee plantation, 16-V-2000, Jarvio 519 (XAL).

***Phylacia mexicana* Medel, J.D. Rogers & Guzmán sp. nov.**

MB510251

FIGS. 7-8, 14

Stromata gregaria, corticibus erumpentibus, superficialia, pseudoturbinate cum ambitibus rotundis praeditae, 5–10 mm alta x 4–10 mm diam., sessilia, plus minusve stipitata, fusca vel nigra, carbonacea, superficie aspro apicem versus. Apex stromatis latus, usque ad maturitatem fatiscentem; ascosporae cum orificio liberatis. Perithecia cylindrica ca. 2 mm longitudine, multa, compacta. Asci saccata, 24–27 x 9.5–10 μ m, octospori. Ascospores luteae vel brunneolae, oblongo-ellipsoideae, leves, 8–9 (–10) x 4–5 μ m, pariete usque ad 0.8 μ m crassae, sine rima germinativa praeditae.

Holotype: Mexico, Chiapas, Palenque ruins, evergreen forest, 19-XII-1985, Chacón 3295 (XAL).

Stromata gregarious, erumpent through bark, superficial, pseudoturbinate, with rounded stromatal edges, 5–10 mm high x 4–10 mm in diameter, sessile or vaguely or definitely stipitate, dark brown to black, carbonaceous surface rough principally toward the apex, apex wide, disintegrating with age and leaving an orifice through which spores are expelled. Perithecia cylindrical ca. 2 mm in length, numerous, compact. Asci saccate, 24–27 x 9.5–10 μ m, octosporous. Ascospores oblong-elliptical, 8–9 (–10) x 4–5 μ m, yellowish-olive to pale brown, wall thick, up to 0.8 μ m, smooth, lacking germ slit.

Habitat and distribution: gregarious on dead wood in evergreen and cloud forests, Mexico

Additional specimens examined—MEXICO. VERACRUZ, Los Tuxtlas region, limits of the UNAM Biological Station, tropical evergreen forest, 17-XII-1985, Chacón 3256 (XAL). Barranca San Miguel, near bridge, highway Fortin-Orizaba, 8-VII-1983, Guzmán 23369. Actopan municipality, Ecological Refuge La Mancha, 7-XII-1994, Leal 487 (XAL)

Comments—As observed in Table 1, the material studied did not match any *Phylacia* species previously described. This fungus is characterized by its stromatal shape and ascospore size; furthermore, the ascospores have a thick wall and the globose asci are small. *Phylacia mexicana* is similar to *P. glandulina* Speer in that both species have small spores, but the former reach up to 9 μ m while the latter reach 11 μ m. Speer (1980) also observed that *P. glandulina* has navicular spores like those of some species of *Xylaria* Hill ex Schrank, whereas in *P. mexicana*, they are oblong-elliptical. Unfortunately, comparison to the *P.*

Table 1. Comparative characters of *Phylacia* species

Species	Spores	Wall	Spore shape	Asci	Stroma shape	Refs.
<i>P. bomba</i>	10-13 x 5-7		oblong	not seen	hemispherical	2,3,4,5
<i>P. bomba</i> var. <i>macrospora</i>	13.5-15.5 (-16.2) x 5.4-7 (-7.2)		oblong	(13.5-)15-18 x 13.6-16	hemispherical	5
<i>P. glandulina</i>	7.5-11 x 5-6		navicular	20-25 x 10-15	clavate	6
<i>P. globosa</i>	9-15 x 5-7.5 (-8.5)	0.5-1	oblong	22-25.5 x 15-17.3	subglobose	2,3,4,5
<i>P. mexicana</i>	8-9 (-10) x 4-5	0.8	oblong	24-27 x 9.5-10	clavate, flat top	
<i>P. poculiformis</i>	7-12.5(-15) x 5.5-7.5 (-9)	0.5-1	elliptic	25-30 x 10-13	pyriform	2,3,4,5
<i>P. pseudohypoxylon</i>	14-15 x 4.5-5		elliptic	45 x 14	cylindric	6
<i>P. pusilla</i>	8-9 x 4.5		ovoid	not seen	cylindric	7
<i>P. sagraena</i>	9.5-11 x 4.5-5.5		elliptic	21-28 x 10-14	pyriform	1,2,3
<i>P. surinamensis</i>	12-13 x 6-7		elliptic	not seen	cylindric	2
<i>P. turbinata</i>	11-13 x 5-6		elliptic	24-35 x 12-15	turbinate	2

References: 1) Ellis & Everhart, 1892; 2) Dennis, 1957; 3) Dennis 1971; 4) Pérez-Silva, 1972, 5) Rodrigues & Samuels, 1989) 6) Speer 1980; 7) Patouillard, 1913.

glandulina type was not possible, as it was not available in PC. With regard to stromatal shape in *P. mexicana*, it is clavate or somewhat obconic with an applanate apex and obtuse edges. A species that has similar characteristics is *P. turbinata*, although its stromata are definitely turbinate with sharp borders and larger, measuring up to 17 mm. According to the type, *P. mexicana* is a small species that only reaches 10 mm in diameter. In its thick-walled ascospores it resembles *P. globosa* and *P. poculiformis*. However, the former has globose stromata and large ascospores up to 15 μm , while in the latter the stroma is pyriform and the spores are large, up to 15 μm . Asci are also somewhat larger (25–30 x 10–13 μm) than those of *P. mexicana*.

Phylacia poculiformis (Kunze) Mont., Ann. Sci. Nat. Bot. Ser. 4, 3: 135. 1855.

FIGS. 3, 10

Stromata globose-pyriform with a narrow apex, stipitate and with thick-walled spores 7–12.5 (–15) x 5.5–7.5 (–9) μm and with wall up to 1 μm thick (see Dennis 1957, 1971; Silveira & Rodrigues 1985; Rodrigues & Samuels 1989). The stromatal size of the examined material agrees with Dennis (1957). It was described earlier from Baja California, Chiapas, Hidalgo, Michoacán, Puebla, Tabasco, and Veracruz (Pérez-Silva 1972, Frutis & Guzmán 1983; Díaz-Barriga et al. 1988).

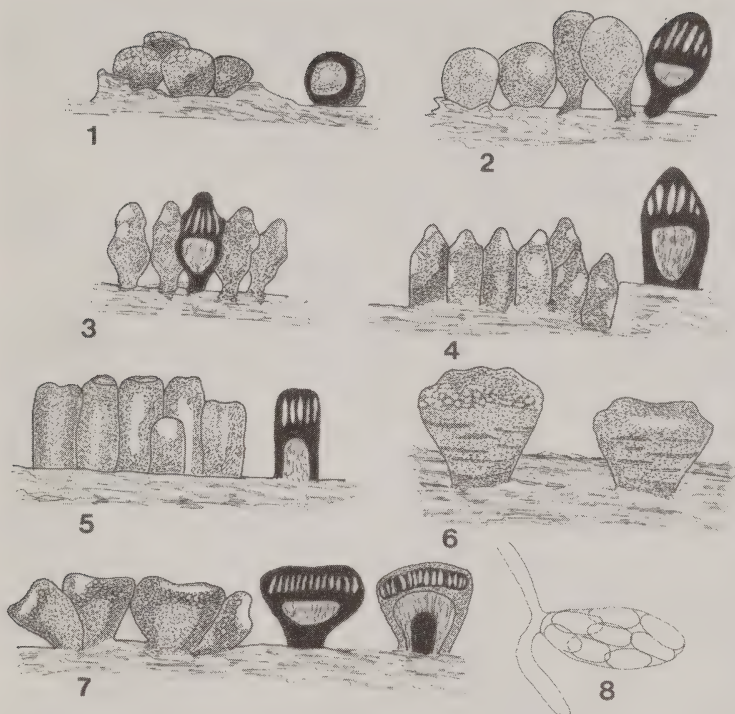
Distribution: Belize, Brazil, Columbia, Ecuador, Guyana, British Guyana, French Guyana, Mexico, Panama, Suriname, Venezuela.

Specimens examined—BELIZE, Stan Creek, Possum Point Biological Station near Sittee Village along Sittee River, on dead log, 14-VI-1992, Vincent 5309 (XAL). MEXICO. CAMPECHE, El Tormento Experimental Site for Tropical Forestry, 18-XI-1980, Chio 220 (ENCB, dupl. XAL); municipality of Calkini, Petenes Zone between El Remate and Punta Arenas, 19-XI-1981, Guzmán 21273 (XAL). CHIAPAS, Rosario Izapa Experimental Agricultural Field, Km 18 Tapachula-Cacahuatan highway, municipality of Tuxtla Chico, various fruit orchards, 15-XII-1995, Chacón 4979 (XAL); Km 40, Palenque-Ocosingo highway, evergreen forest, 20-XII-1985, Chacón 3478 (XAL); municipality of Ocosingo, 2 km south of the Plan de Ayutla Bridge, evergreen forest, 22-I-1984, Sampieri 773 (XAL). OAXACA, pine plantation for the Tuxtepec paper factory, tropical zone, 21-VIII-1976, Betancourt 161 (ENCB, dupl. XAL). YUCATAN, Felipe Carrillo, Puerto Laguna Cana, 4-V-1990, Ancona 85 (XAL). Veracruz, El Morro de la Mancha Biological Station, VERACRUZ, municipality of Actopan, 14-IX-1989, Bandala 1742 (XAL); sandy tropical forest, 26-VIII-1983, Chacón 1454 (XAL); Jalcomulco municipality, La Gotera ravine, cloud forest, 23-12-2000, Jarvio 860 (XAL); municipality of Las Choapas, 'El Milagro' Ranch, 5 km SW of Nueva Tabasqueña, 9-XII-2005, R. Medel 1195, 1198, 1206 (XAL).

Phylacia sagraeana (Mont.) Mont., Syll. Gen. Spec. Crypt.: 259. 1856.

FIGS. 4, 11

Stromata pyriform with a wide base, 1.5–3 mm wide and 2.6–6 mm high and ascospores 9.5–11 x 4.5–5.5 μm ; these are salient characteristics of this species,



Figs. 1–8. 1: *Phylacia bomba* stromata and longitudinal view showing endostroma; 2: *P. globosa* stromata and longitudinal view showing endostroma; 3: *P. poculiformis* stromata and longitudinal view showing endostroma; 4: *P. sagraeana* stromata and longitudinal view showing endostroma; 5: *P. surinamensis* stromata and longitudinal view showing endostroma; 6: *P. turbinata*, stromata; 7–8 *P. mexicana*. 7: stromata and longitudinal view showing endostroma; 8: asci and ascospores.

according our observations and fide Dennis (1957). Rogers has observed what appear to be germ slits in a collection from Costa Rica (unpublished data). The stromata of the studied material are 2–6 mm broad and 1.5–6 mm high. This species is known from Mexico from the states of Tabasco and Veracruz (Pérez-Silva 1972).

Distribution: Cuba, Mexico, Nicaragua, Panama, Venezuela.

Specimens examined—CUBA. Mirador Biosphere Reserve, MAB region, Sierra del Rosario, Pinar Del Río, subtropical *Pinus* and *Quercus* rainforest, 27-X-1996, Guzmán 31736 (XAL). MEXICO. CHIAPAS, municipality of Ocosingo, Lacanjá-Chanzayab,

evergreen forest, 14-I-1984, Sampieri 608, 20-XII-1985, Chacón 3445 (XAL). NUEVO LEON, municipality of Allende, Potrero del Alamo Ranch, tropical deciduous forest, 16-V-1994, Medel 619 (XAL). OAXACA, Putla de Guerrero, 25-V-1969, Zavala *s.n.* (ENCB, dupl. XAL). QUINTANA ROO, 20 km south of Km 77, Chetumal-Escarcega highway, road to Tomas Garrido before the turn-off to Tres Garantías, 8-XI-1981, Guzmán 20950 (XAL). VERACRUZ, municipality of Actopan, El Morro de la Mancha Ecological Reserve (CICOLMA), tropical deciduous forest, Chacón 5081 (XAL); Fortín de las Flores (Posada de la Loma), 9-VII-1983 Guzmán 23376 (XAL); Los Tuxtlas region, municipality of Catemaco Ejido López Mateos, tropical deciduous forest, 28-VI-1987 Chacón 4003 (XAL).

Phylacia surinamensis (Berk. & M.A. Curtis) Dennis, Kew Bull 12: 325. 1957.

FIGS. 5, 12

Stromata cylindrical, with center of stromatal apex concave, ascospores 12–13 x 6–7 μm , according to Dennis (1957) and Silveira & Rodrigues (1985). There are no data about stromata size in the literature, but the stromata of the material examined are 1.5–3 mm broad and 2.5–6 mm high. *P. surinamensis* is previously unreported for Mexico.

Distribution: Brazil, Guatemala, Mexico, Suriname.

Specimens examined—MEXICO. OAXACA, Cerro Cebastopol, 10 km south east of Tuxtepec, tropical zone, 2-VIII-1976, Betancourt 12 (ENCB, dupl. XAL). VERACRUZ, municipality of Hidalgotitlán, Los Tuxtlas region, district of Uxpanapa, south west of highway 104, south east of Hermanos Cedillo, tropical forest, 17-III-1976, Guzmán 15527 (ENCB, dupl. XAL).

Phylacia turbinata (Berk.) Dennis, Kew Bull. 12: 323. 1957.

FIGS. 6, 13

Stromata turbinate widening underneath the fertile part, ascospores 11–13 x 5–6 μm , fide Dennis (1957, 1971) and Silveira & Rodrigues (1985). According to our observation this is the largest species in the genus, reaching up to 17 mm diameter. Known from Mexico in Puebla, Quintana Roo, and Veracruz (Perez-Silva 1972).

Distribution: Brazil, Mexico, Paraguay.

Specimens examined—BRAZIL, Bahía, Challenger Expedition, Sao Leopoldo, Santa Catherina, 1879, Theissen *s.n.* (K, TYPE); Mata de Cantareira, Instituto Florestal Parque Estadual de Cantareira, near Sao Paulo, 5-III-1971, Guzmán 8865 (ENCB, dupl. XAL).

Phylacia species not examined

We were unable to evaluate type material of *P. glandulina*, *P. pseudohypoxylon* at PC and *P. pusilla* at FH since material was unavailable for study. We do include them in our key for completeness.



Figs 9–14. Scanning electron micrographs of spores (scale: 4000 $\times$).

9: *P. globosa*; 10: *P. poculiformis*; 11: *P. sagraeana*;
12: *P. surinamensis*; 13: *P. turbinata*; 14: *P. mexicana*.

Generic affinities of *Phylacia*

The affinities of *Phylacia* are unclear. Speer (1980) erected family *Phylaciaceae* to include *Pulveria* Malloch & Rogerson (Malloch & Rogerson 1977) and *Phylacia* based primarily on the cleistocarpous habit and globoid asci of these genera. Rodrigues & Samuels (1989) reported *Geniculosporium* anamorphs for two *Phylacia* species and considered this as evidence supporting inclusion of *Phylacia* in family *Xylariaceae*. Stadler et al. (2005) put *Pulveria* into synonymy with *Pyrenomyxa* Morgan emend. M. Stadler et al. These authors did not regard *Phylacia* and *Pyrenomyxa* as closely related genera. In our opinion there is no evidence to support a relationship between *Phylacia* and *Pyrenomyxa*. Although both genera feature cleistocarps, those of *Phylacia* bear multiple tubular structures that produce asci in morphologically discrete structures. Those of *Pyrenomyxa* produce ellipsoid to fusoid ascocarps in an effusive hypoxylloid stroma. Ascospores of *Pyrenomyxa* are inequilateral and bear definite germ slits (Stadler et al. 2005). Those of *Phylacia* are more or less equilateral (except for taxa described by Speer 1980) and are apparently devoid of germ slits (but see earlier remarks of *P. sagraeana* herein). Ju et al. (1997) suggested a possible connection between *Pulveria* (= *Pyrenomyxa*) and *Rhopalostroma* D. Hawksw. Stadler et al. (2005) found similar metabolites in *Rhopalostroma* and *Phylacia*. They suggested that *Phylacia* is possibly related to *Rhopalostroma*, *Thamnomycetes* Ehrenb., and *Daldinia* Ces. & de Not. In our opinion, the understanding of taxonomic affinities of *Phylacia* awaits molecular data.

Key to known *Phylacia* species

1. Stromata sessile 2
1. Stromata stipitate or pseudostipitate 5
 - 2 Stroma hemispherical 3
 - 2 Stroma cylindrical, with a concave center 4
3. Ascospores less than 14 μm long *P. bomba*
3. Ascospores more than 14 μm long *P. bomba* var. *macrospora*
 4. Ascospores 12-13 x 6-7 μm *P. surinamensis*
 4. Ascospores 8-9 x 4-5 μm *P. pusilla*
5. Stromata obpyriform or pyriform 6
5. Stromata other than pyriform 7
 6. Stromata more or less obpyriform. Ascospores up to 11 μm long, thin-walled
..... *P. sagraeana*
 6. Stromata roughly pyriform. Ascospores up to 15 μm long, thick-walled
..... *P. poculiformis*

7. Stromata more or less cylindrical *P. pseudohypoxylon*
 7. Stromata other than cylindrical 8
8. Stromata globose to clavate. Ascospores thick-walled *P. globosa*
 8. Stromata clavate, turbinate, or glanduliform (acorn-shaped) 9
9. Stromata turbinate, up to 17 mm diam *P. turbinata*
 9. Stromata glanduliform or clavate 10
10. Stromata glanduliform *P. glandulina*
 10. Stromata clavate, up to 10 mm diam *P. mexicana*

Final comments

With the inclusion of *P. mexicana*, there are ten species and one variety ascribed to this genus, of which 7 species and one variety are present in Mexico and the others, *P. pseudohypoxylon* and *P. glandulina*, are found in Brazil and Ecuador, respectively. The latter two have only been recorded in literature (Speer 1980), and the types were unavailable in PC. On the other hand *P. pusilla* is a doubtful species, fide Hawksworth (1977). However, if it were shown to be a *Phylacia* it would be the first report of a species from Asia and, indeed, from outside the Americas.

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The typification of *Lecanora dispersa* and *L. albescens*

LUCYNA ŚLIWA

ibslwiwa@ib-pan.krakow.pl

Laboratory of Lichenology, W. Szafer Institute of Botany
Polish Academy of Sciences, Lubicz 46, PL-31–512 Kraków, Poland

Abstract—The nomenclature, citation, and typification of the names *Lecanora dispersa* and *L. albescens* are discussed, and neotypes are designated for both species epithets in order to maintain current usage. In addition, descriptions and information on exsiccates examined are presented.

Key words—Ascomycota, Lecanorales, lichens, nomenclature

Introduction

The *Lecanora dispersa* group is considered as the most difficult in its genus (Laundon 2003), and its taxonomy has been struggled over for almost over 50 years (Laundon 1958, Fröberg 1989, 1997, Poelt et al. 1995). The species are superficially quite similar and characterized by an endolithic or endophloedic (rarely superficial) thallus, small apothecia with mostly white thalline exciples, and either with xanthonenes present or secondary compounds not being detected by TLC. The first attempt towards a modern taxonomy of the group was that of Poelt et al. (1995), who considered the saxicolous species in the eastern Alps. Those authors precisely circumscribed 11 species based on combinations of anatomical and chemical characters. None of the names adopted, however, were typified in that work. Moreover, some taxa, e.g. *Lecanora flotoviana*, remained ambiguous. Poelt et al. (1995) pointed out some problems with species delimitation, especially from poorly developed forms of *L. dispersa* as well as its unclear relationship to *L. xanthostoma*. Fröberg (1997) studied the species of south Sweden, validated the name *L. xanthostoma*, and described a new species, *L. perpruinosa*; however, concerning older names, he did not refer to any original collections. The adoption and attribution of the name *L. flotoviana* by Fröberg is intriguing. Contrary to a previous publication (Fröberg 1989), in his 1997 treatment Fröberg (1997) adopted the epithet “*flotoviana*” for saxicolous morphs of *L. dispersa* auct. and retained the name *L. dispersa*

exclusively for corticolous representatives of the complex. This interpretation caused differing applications of the two names in recent years, and further confusion as to species concepts. More recently, Laundon (2003), in a work primarily on the status of *L. zosteræ* in Great Britain and Ireland, briefly discussed the whole group of species, lectotyped *L. umbrina*, and proposed the name be used for *L. hagenii* auct., a name that proved to have been misapplied. A formal proposal to enable the name *L. hagenii* to be retained by conservation is being made separately (Šliwa & Hawksworth 2006).

This paper is part of a broader study intended as a revision of the North American collection of the *L. dispersa* group and related species (Ryan et al. 2004, Šliwa, unpubl.). The majority of available names within this group of taxa are based on European types, and therefore in most cases material from both continents had to be compared. The study is based on material from the following North American herbaria: ASU, CANL, COLO, FH, NY, MICH, MIN, MSC, OMA, OSC, US, WIS, and herb. Spribille. Types and/or historical materials of most of the 33 names at the rank of species and below were examined, as well as other reference specimens from many important European herbaria: B, BM, GOET, GZU, H, KRAM, L, LD, LE, M, S, and UPS. In total, about 1900 specimens were studied morphologically, microscopically, and many of them chemically. An effort to trace available original collections led to many interesting discoveries and taxonomic conclusions.

Especially pertinent is the exclusion of *L. flotoviana* from the *L. dispersa* group, based on original material of the species recently discovered at B and GOET. The collections differ in morphology and chemistry from the entity usually known by that name. Indeed, the taxon does not even belong to the *L. dispersa* complex. Instead, *Lecanora semipallida* is the correct name for the common, widespread member of the *L. dispersa* group hitherto known as *L. flotoviana* (auct. non Spreng.). Full details of the status and application of the names are being published separately. Typifications of the two oldest names in the complex, *L. dispersa* and *L. albescens*, are presented here. Since the protologues of the species are very short and of very general character, the selection of material for the typification was made to preserve the current usage of the names as defined by Poelt et al. (1995).

Typifications

Lecanora dispersa (Pers.) Sommerf., Suppl. Fl. Lapp.: 96 (1826).

Basionym: *Lichen dispersus* Pers., Neue Ann. Bot. 1 [Ann. Bot. 7]: 27 (1794).

Type: [Germany, Hessen] "Mitteldeutschland, Bez. Nordhessen: kleinflächig an licht- und windoffenen, aber teilweise regengeschützten Stirn- und Überhangflächen stark ausgearbeiteter Dolomithfelsen im *Caloplectum saxicolae* Du Rietz, 300 m, SO-SW, ph 7,5, naturnaher Trockenrasen auf dem Höhenzug in der Werraschleife von

Albungen südlich Hitzerode. Leg. et det. G. Follmann und B. A. Follmann (IV/1977). Follmann" [Follmann, Lich. Exsicc. Selecti 387, sub *L. albescens*] (MIN! – **neotypus hic designatus**; ASU!, BM!, COLO!, WIS! – isoneotypi). [This exsiccate collection was also distributed to: B, BRA, CANL, FH, GZU, H, L, LD, MAF, M, NY, TNS, US, W, etc. (Follmann 1983)].

Synonym:

Lecanora subluta var. *perspersa* Nyl., Flora 59: 233 (1876).

Type: [Ireland] "Hibernia, Dawros Bridge, 1875, leg. C. Lorbalestier 19" (H-NYL 28069! – **lectotypus hic designatus**; BM! – 2 isoelectotypi).

Thallus mostly endolithic, or sometimes superficial but indistinct, very thin, ecorticate (except with some corticate granules near the apothecia); pale grey. **Apothecia** occurring singly, or clustered in groups, sessile, or constricted at the base, concave, flat when mature or soon convex, 0.3–0.9 mm; disc pale brown, dark brown or almost black, smooth, epruinose or rarely slightly pruinose; thalline exciple prominent, raised or even with disc, uniform, epruinose or pruinose, even, or slightly flexuose, white, or concolorous with thallus, rarely concolorous with disc, not crenulate; amphithecium present, with algae filling the medulla or algae sparse, algal layer often discontinuous below hypothecium, (60–)90–200 μm thick, corticate; cortex indistinctly delimited, $\pm$ uniform in thickness, or slightly thicker at the base than at the sides, 30–80 μm thick laterally and 35–120 μm thick at base, composed of adglutinated hyphae to apparently cellular, $\pm$ obscured by granules (pol+, insoluble in K, soluble in N); parathecium indistinct to well delimited and to 30 μm wide; epihymenium shades of yellow or brown, granular (pol+), granules superficial and between paraphyses tips, or also interspersed in the whole hymenium, fine (insoluble in K and insoluble in N), sometimes with an epipsamma (insoluble in K and soluble in N); hymenium hyaline, or pale yellow, 45–70 μm high; subhymenium indistinct; hypothecium hyaline or almost so, 40–120 μm thick, composed of adglutinated hyphae to apparently cellular, often with some granules. **Paraphyses** slender, somewhat branched throughout, with few anastomoses, not expanded and usually not pigmented, coherent in K. **Asci** clavate, 40–60 $\times$ 10–15 μm , 8-spored. **Ascospores** hyaline, simple, ellipsoid, (7.5–)9–12 $\times$ (4.5–)5–6 μm . **Pycnidia** not seen. **Spot tests**: apothecial margin K–, C–, KC–, PD– or PD+ orange ($\pm$ 75%); disc K–, C–, KC–, PD–; apothecia UV negative or $\pm$ pale yellow or green. **Secondary compounds**: 2,7-dichlorolichexanthone, $\pm$ pannarin; or no lichen substances detected by TLC.

Habitat: On a wide range of substrata including calcareous and siliceous rocks, concrete and mortar, dust contaminated bark, lignum and many manufactured substrata including asbestos, metal, leather, rubber; also commensalistically on other lichens.

World distribution: widespread, especially in temperate region.

ADDITIONAL EXSICCATA EXAMINED – Arnold, Lich. Exsicc. 1703 (as *L. albescens*, lignicolous) (M, MIN); Arnold, Lich. Monac. Exsicc. 142 (as *L. albescens*, lignicolous) (M); Arnold, Lich. Monac. Exsicc. 232 (as *L. dispersa*) (M); Arnold, Lich. Monac. Exsicc. 432 (as *L. albescens*, lignicolous) (M); Arnold, Lich. Monac. Exsicc. 433 (as *L. dispersa*) (M); Arnold, Lich. Monac. Exsicc. 513 (as *L. dispersa*) (M, MIN); Cummings, Decad. N. Am. Lich. 300 (as *L. hagenii*) (WIS); Cummings & al., Lich. Boreali-Am. 249 (as *L. hagenii*) (COLO, FH 2x, MICH); Erbar. Crittogam. Ital. Ser. II. 615 (as *L. flotowiana*) (MIN); Hasse, Lich. Exsicc. 240 (as *L. hagenii*) (COLO); Malme, Lich. Suecici Exsicc. 496 (as *L. hagenii*) (WIS); Merrill, Lich. Exsicc. 113 (as *L. hagenii*) (COLO, FH 2x, MICH); Nowak, Lich. Polon. Merid. Exsicc. 223 (as *L. umbrina*) (KRAM, MIN); Rabenhorst, Lich. Eur. 624 (as *L. hagenii* f. *lithophila*) (KRAM).

SYNOPSIS OF MATERIAL SEEN – Antarctica (Šliwa & Olech 2002), Armenia (COLO), Australia (COLO, MIN), Austria (GZU, KRAM), Canada (ASU, CANL, COLO, FH, H, MICH, MIN, NY, OMA, WIS), Chile (COLO), Estonia (KRAM), Germany (COLO, GOET, L, MSC, WIS), Hungary (NY), Mexico (ASU, COLO), Poland (KRAM), Romania (KRAM), Sweden (ASU, COLO, LD, NY, WIS), Switzerland (COLO), UK (KRAM, NY), Ukraine (KRAM), USA (ASU, CANL, COLO, FH, KRAM, NY, MICH, MIN, MSC, US, WIS).

Comments – In the Persoon herbarium in L there is now no collection of *Lecanora dispersa* (Gerard Thijssse, pers. comm.). Nor could any Persoon specimen of the taxon be traced in the Acharius herbarium in Helsinki. However, there is material in BM that purports to be authentic which was collected in Jena in 1798 and has the number “27”, the page on which Persoon’s name was published, but it is in poor condition so unsuitable for choice as neotype; the handwriting may well be the coarse script of Persoon, but the specimen was evidently annotated even later than 1798 as the genus name *Parmelia* is used, a combination not published until 1803 by Acharius. In H-ACH there is a single packet of *Lecanora dispersa* (H-ACH 1228) bearing four specimens, which represent three different species: (1) *L. crenulata* Hook., one specimen originating from “Suecia”; (2) *L. crenulata* Hook., a second specimen with no locality provided; (3) *L. semipallida* H. Magn., with the locality indication “Anglia”; and (4) a very small and poorly developed specimen of *L. dispersa* with no further indications. The last collection has nothing to link it with Persoon and appears unsuitable for neotypification as it is so poor. Other herbaria supposedly holding Persoon’s material were contacted unsuccessfully. Apparently all original material has been lost. In such a situation exsiccate collections were assessed as candidates for neotypification so as to supply easily accessible reference collection. Priority was given to collections originating from Germany as the following locality directions were indicated in the Persoon’s work: Meissner Mountains (south-east of Kassel and south-west of Leipzig, Germany). Furthermore, Persoon indicated his material was from calcareous rocks. The selection was not an easy task, taking into account the species’ considerable variability and wide range of occupied substrata. Finally, the Follmann exsiccatum was chosen as the

best specimen of those seen as it was best developed and on calcareous rock. The collection was originally determined as *L. albescens*. However, no proper thalline areole were observed on any of examined specimens, but there were granular-looking young apothecia, which I suspect Follmann misinterpreted as thallus tissue and led to a misidentification.

***Lecanora albescens* (Hoffm.) Flörke, in Flotow, Flora 11: 633 (1828).**

Basionym: *Psora albescens* Hoffm., Deutschl. Fl. 2: 165 (1796).

Type: [Germany, München] "Auf Ziegeln der Kirchhofmauer in Thalkirchen; München, Dezember 1891, Arnold und Schnabl". [Arnold, Lich. Monac. Exsicc. 212; sub *L. albescens*] (H! – **neotypus hic designatus**; M!, MIN! – isoneotypi).

Synonyms:

Lecanora galactina Ach., Lichenogr. Univers.: 424 (1810).

Parmelia galactina Ach., Method. Lich.: 190 (1803); nom. illegit. (Art. 52.1).

Lecanora urbana (Nyl.) Leight., Ann. Mag. Nat. Hist., ser. 4, 2: 247 (1868).

Lecanora galactina [subsp.] *urbana* Nyl., Bull. Soc. Bot. France 13: 368 (1866).

Type: [France] "Gallia. Paris: rue de l'Ouest, sur les murs. 1866, leg. W. Nylander" (H-NYL 28057! – holotype).

Thallus clearly visible, often forming distinct rosettes, thick or thin, areolate, edge distinctly lobate and mostly continuous, surface pruinose; pale grey, cream or chalk-white. **Apothecia** clustered in groups on thallus areoles, sessile or slightly immersed, flat when mature, 0.4–1.4 mm; disc yellowish to pale brown, slightly to heavily pruinose; thalline exciple prominent, smooth, uniform, epruinose, even, or flexuose, concolorous with thallus; amphithecium present, with algae filling the medulla or algae sparse, algal layer continuous below the hypothecium, 90–270 μm thick, corticate; cortex indistinctly delimited, or distinctly delimited, $\pm$ uniform in thickness, or slightly thicker at the base than at the sides, ca. 30 μm thick laterally and ca. 60 μm thick at base, prosoplectenchymatous, gelatinous, obscured by granules and larger crystals (pol+, insoluble in K, slowly soluble in N); parathecium indistinct to well delimited and up to 30 μm wide; epihymenium shades of yellow or brown, granular (pol+), granules superficial and between paraphyses tips, also interspersed in whole hymenium, coarse, or fine (insoluble in K and insoluble in N), usually with an epipsamma (insoluble in K and soluble in N); hymenium hyaline, or yellowish, 60–90 μm high; subhymenium distinct; hypothecium hyaline or almost so, 60–130 μm thick, composed of prosoplectenchyma, without granules. **Paraphyses** slender, somewhat branched throughout, with few anastomoses, not expanded and not pigmented, $\pm$ coherent in KOH. **Asci** clavate, 50–60(–65) $\times$ 10–15 μm , 8-spored. **Ascospores** hyaline, simple, ellipsoid (9–)10.5–13(–15) $\times$ 4.5–6(–7.5) μm . **Pycnidia** not seen. **Spot tests:** apothecial margin K–, C–, KC–, PD– or PD+ orange; disc K–, C–, KC–, PD–; apothecia UV negative. **Secondary compounds:** 2,7-dichlorlichexanthone, $\pm$ pannarin; or no lichen substances detected by TLC.

Habitat: Directly on calcareous rocks, especially hard limestone, and also on concrete and mortar.

World distribution: Frequent in Europe (from boreal to Mediterranean regions) and scattered on the northern-east coast of North America.

ADDITIONAL EXSICCATA EXAMINED – Arnold, Lich. Monac. Exsicc. 29 (as *L. albescens*) (M); Flörke, Deutsche Lich. 89 (as *L. angulosa* var. *galactina*) (M); Hepp, Lich. Helvet. Exsicc. 900 (as *L. galactina*) (NY); Malme, Lich. Suecici Exsicc. 869 (as *L. galactina*) (COLO, WIS); Mereschkowsky, Lich. Rossiae Exsicc. 9 (as *L. crenulata*) (COLO); Nowak, Lich. Polon. Merid. Exsicc. 63 (as *L. albescens*) (COLO, KRAM, MIN); Rabenhorst, Lich. Eur. 596 (as *L. albescens* f. *murorum*) (COLO).

SYNOPSIS OF MATERIAL SEEN – Austria (ASU, GZU, MIN), Canada (CANL, H, MICH, MIN, US), Denmark (MIN, WIS), Estonia (KRAM), Finland (COLO), Germany (GOET), Malta (NY), Poland (KRAM), Romania (KRAM), Sweden (COLO, LD, MIN, WIS), Switzerland (NY), UK (COLO, KRAM, MSC, NY), Ukraine (KRAM), USA (NY).

Comments – As no original Hoffmann collection could be located in B, GOET or MW, the herbarium in Helsinki was checked to trace any relevant material appropriate for typification. However, no authentic *L. albescens* was found there, although original collections of the species' later synonyms, *L. galactina* and *L. urbana* were located. The Acharian collection of *L. galactina* is included on one sheet and bears several specimens originating from “Gallia”, “Helvetia” and “Suecia”. *Lecanora urbana* is represented in H-NYL by two collections, one of which has an original label indicating a locality conforming to the species protologue, and also bearing some drawings and notes. Since it is rather unlikely that any other original collection exists, this last specimen is recognized as the holotype for Nylander's name here. Both *L. galactina* and *L. urbana* are identifiable as the species to which the name *L. albescens* is currently applied.

Regarding neotypification of *L. albescens*, priority was given again to exsiccates, and especially those collected in Germany since Hoffmann material would have originated from that country. The Arnold exsiccatum is selected as neotype for Hoffmann's name here because it corresponds exactly with the current concept of this species and unequivocally fixes its application; copies are also widely distributed. Branth & Rostrup (1869: 196) are commonly given as the authors of the combination *L. albescens*, while many earlier lichenologists attributed the name to Flörke. However, although Flotow did not accept Flörke's combination but regarded it as a synonym of *L. flotoviana* Spreng., he published Flörke's text from a manuscript and then commented on it. The case is identical to that of Art. 34.1 Ex. 3 introduced into the Vienna Code and Flörke's combination now has to be accepted as valid under the Code.

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**A taxonomic study of *Protoparmelia montagnei*
(syn. *P. psarophana*) centered in the Eastern Iberian Peninsula**

MERCEDES BARBERO^{1*}, MIREIA GIRALT²,
JOHN A. ELIX³, ANTONIO GÓMEZ-BOLEA¹ & XAVIER LLIMONA¹

*mbarbero@ub.edu

¹Dep. Biologia Vegetal, Fac. Biologia, Univ. Barcelona
Diagonal 645, 08028 Barcelona, Spain

²Dep. Bioquímica i Biotecnologia, Univ. Rovira i Virgili
Marcel·lí Domingo s/n, 43007 Tarragona, Spain

³Department of Chemistry, Australian National University
Canberra, ACT 0200, Australia

Abstract—A comparative study of collections of *Protoparmelia montagnei* and *P. psarophana* from the Eastern Iberian Peninsula has been made on the basis of their morphology, chemistry, habitat and distribution. Some additional specimens from adjacent Mediterranean regions have also been studied for comparison purposes. Four chemotypes of *P. montagnei* have been detected: chemotypes I, II and III, were previously known for this species but are reported for the first time from the study area. Additional secondary metabolites have now been detected in chemotypes I and II and a fourth chemotype characterized by the presence of a chemosyndrome of fatty acids is described. *Protoparmelia psarophana* is now placed into synonymy with *P. montagnei*. A comprehensive description of *P. montagnei* is presented (including several new characters) together with illustrations and a distribution map of the chemotypes in the study area.

Key words—lichenized ascomycetes, taxonomy, ecology

Introduction

As part of a comprehensive revision of the genus *Protoparmelia* M. Choisy in the Iberian Peninsula we have studied the type specimens of *P. montagnei* (syn. *Parmelia montagnei*; *Lecanora montagnei*) and *P. psarophana* (syn. *Lecanora psarophana*) as well as additional specimens labelled as *P. montagnei*, *P. psarophana* var. *psarophana*, *P. psarophana* var. *aquilina*, and *P. psarophana* var. *reagens* (syn. *Lecanora psarophana* var. *reagens*) from the eastern Iberian Peninsula and adjacent Mediterranean regions.

Of the c. 10 species of *Protoparmelia* described previously (see Hafellner 1984, Purvis et al. 1992, Poelt & Leuckert 1991, Poelt & Grube 1992), the silicicolous

Protoparmelia montagnei and *P. psarophana* closely resemble *P. badia* (Hoffm.) Hafellner, the type species of the genus. All three taxa are characterized by a brown thallus, a cupular exciple, pleurogenously born, bacilliform conidia and $\pm$ *Lecanora*-type asci with narrow ascospores (ascospores which are sharply fusiform in *P. badia* but with rounded apices in *P. montagnei* and *P. psarophana*). Additional differences are found in the chemistry, ecology and distribution of the three species. *Protoparmelia badia* contains lobaric acid, zeorin, several unknowns and sometimes accessory usnic acid (Ryan et al. 2005), and has a worldwide distribution in montane to alpine habitats, whereas *P. montagnei* and *P. psarophana* contain lobaric, gyrophoric, lecanoric and fatty acids (depending on the respective chemotypes), and have a Mediterranean-Macaronesian distribution in coastal and low mountains habitats.

The differences between *P. montagnei* and *P. psarophana* have been discussed at length, especially by lichenologists working on Mediterranean species, but their distinction remains somewhat controversial. An historical review of their status according to previous workers follows.

Ozenda & Clauzade (1970) and Clauzade & Roux (1985) distinguished *Protoparmelia montagnei* from *P. psarophana* morphologically, by the presence of marginal thalline lobes and larger ascospores, and ecologically, by its preference for warmer localities.

Many studies on silicicolous lichens in the eastern Iberian Peninsula (e.g. Egea & Llimona 1981a, b, c, 1982, 1983) have recognized both taxa, treating them as altitudinal vicariants, *P. montagnei* occurring in coastal areas and *P. psarophana* in hinterland ranges. In our opinion this ecological view was overemphasized when Egea & Llimona (1987) described the alliances *Lecanorion montagnei* and *Pertusarion leucosorae* on siliceous rocks from the Murciano-Almeriense chorological region (SE Spain), assigning different phytocoenological behaviour to *L. montagnei* and *L. psarophana*. In their view *Lecanora montagnei* was the characteristic species of the former syntaxon which included typically thermophylous coastal communities whereas *L. psarophana* was better represented in associations belonging to the second syntaxon containing less thermophylous and xerotolerant communities in hinterland or higher altitude localities with higher rainfall and lower winter temperatures.

The taxonomic study on Iberian *Protoparmelia* carried out by Sancho & Crespo (1987), treat somewhat superficially *Lecanora montagnei* and *L. psarophana* and invalidly transferred them into the genus *Protoparmelia*. The combination *Protoparmelia montagnei* was validly published by Nimis & Poelt (1987). In the latter study *Lecanora psarophana* (incl. var. *aquilina*) and several other Mediterranean taxa (e.g. *Placodium fuscopallens* Kremp. and *Lecanora stenosporea* Hue) were synonymized with *P. montagnei*. According to these authors there were "no real differences" between *P. montagnei* and *P. psarophana*, they being morphologically very similar albeit chemically distinct.

However, in a subsequent floristic study centred in the Island of Capraia (Italy), Nimis et al. (1990) stated that material of *Protoparmelia montagnei* s.l. definitely included two taxa, *P. montagnei* with sublobate and thicker thallus and *P. psarophana* with crustose and non-effigurate thallus and that intermediate forms were absent. They concluded that the entire group should be distinguished on the basis of chemical characters.

Following a morphological and chemical study of French collections Ménard & Roux (1991) considered the two taxa to be synonymous. Nevertheless, they preferred to maintain both taxa because their synonymy would have syntaxonomic consequences, as *Protoparmelia montagnei* is the characteristic species of the alliance *Lecanorion montagnei*. In addition, these authors considered that *P. psarophana* var. *aquilina* merited conservation because of its distinctive chemistry (it contains only gyrophoric acid).

Purvis et al. (1992) like Nimis & Poelt (1987), considered *P. psarophana* and *P. montagnei* to be conspecific but distinguished three chemotypes within this species: (1) with lobaric and gyrophoric acids; (2) with lobaric acid; and (3) with gyrophoric and lecanoric acids.

Notwithstanding this, Nimis (1993) recognized both species and validated the combination *Protoparmelia psarophana* initially proposed by Sancho & Crespo (1987). Although subsequent investigators (Sipman & Raus 1995, 1999, 2002) were aware that a thorough comparative study was necessary to decide whether *P. montagnei* and *P. psarophana* were synonymous, they preferred to maintain both taxa as separate species for the interim.

The main aim of the present investigation was to study the morphological and chemical variability and the ecological behaviour of *P. montagnei* and *P. psarophana* in the eastern Iberian Peninsula where both "species" are well represented, and by so doing, attempt to clarify whether they should be regarded as synonyms or not.

Materials and methods

The present study was based on field investigations and the examination of approximately 100 collections of fresh and herbarium material housed in: B, BCC, H, MAF, MUB, UPS, VAB and the herbarium of Claude Roux.

All specimens were analysed by standard techniques with stereoscopic and compound microscopes. Current mycological terminology generally follows Kirk et al. (2001). The terminology used for the asci follows Hafellner (1984) and for the conidiophores and conidia, Vobis (1980). Only free ascospores and conidia lying outside the asci and pycnidia, respectively, have been measured. Measurements were made in water at 1000x magnification. Mean value (M) and standard deviation (SD) were calculated. In the text the results are given

as (minimum value observed) $M \pm SD$ (maximum value observed). M , SD and n (the total number of ascospores or conidia measured) are given within parentheses.

Acetone insoluble lichen pigments were tested following the protocol of Meyer & Printzen (2000). Chemical constituents were identified by thin layer chromatography (TLC) (Culberson & Ammann 1979, Culberson et al. 1981, Culberson & Johnson 1982, Elix & Ernst-Russell 1993), high performance liquid chromatography (HPLC) (Elix et al. 2003, Feige et al. 1993) and comparison with authentic samples. The numeration given for the chemotypes follows Purvis et al. (1992).

General description of the species

Protoparmelia montagnei (Fr.) Poelt & Nimis

Figs. 1 - 5

[In Nimis & Poelt] *Studia Geobot.* 7(1): 188 (1987). *Parmelia montagnei* Fr., *Lichenogr. Eur. Ref.*: 107 (1831); *Lecanora montagnei* (Fr.) Schaer., *Enumeratio Critica Lich. Europ.* : 62 (1850). Type: Gallia, Provence, îles d'Hyères, 1820-1830?, Montagne (UPS (L-08014) 19666—holotype!).

Synonym (revalidated here): *Protoparmelia psarophana* (Nyl.) Sancho & A. Crespo [in Nimis], *Mus. Reg. Scienc. Nat. Torino*: 576 (1993). *Lecanora psarophana* Nyl., *Bull. Soc. Linn. Normand., 2e sér., Tom. VII*: 10, 1872. Type: France, Pyr. Orient., col de Pall, 900 m, 1872, Nylander (H—Nyl. 25687—lectotype!).

New synonyms: *Protoparmelia psarophana* var. *reagens* (Servit) Sipman, *Willdenowia* 29: 278 (1999). *Lecanora psarophana* var. *reagens* Servit, *Ann. Naturhist. Mus. Wien* 46: 85 (1931). Type: Kykladen, Naxos, auf Gneiss, Berg Ozia, Rechinger-1619, 1620 (not seen); *Lecanora psarophana* var. *aquilina* Clauzade & Cl. Roux, *Bull. Soc. Bot. Centre-Ouest, Nouv. Sér. Num. Spéc.* 7: 823 (1985). Type: France: Provenço, Bouches-du-Rhône, la Ciotat, golfeto de Figuerolles, sur apudmara krutajo NNW- orientiga, el turonia pudingo (shtonoj el nekalka, kvarcita grejso; cementajho apenau kalka), 10 m. 10/7/76, Roux (Hb Roux-holotype!, isotypes!).

Thallus crustose, continuous, very variable, thin and rimose-areolate or areolate, to thick, strongly warted to bullate or even subsquamulose, from (0.25-)0.75-1.5(-2.5) mm thick; usually chesnut-brown to grey-brown or reddish (coppery)-brown, $\pm$ dark brown, sometimes pale grey, cream, olivaceous or brownish black; uniformly coloured or mottled, epruinose or very rarely pruinose, glossy or not; determinate, sometimes radiate with an outer sterile part radially structured and sometimes showing tendency to form marginal lobes (effigurate); especially young thalli delimited by a blackish hypothalline line. Central cracks or areolae, irregularly shaped, $\pm$ round or irregularly polygonal, 0.2-2.5 mm across, flat to subconvex or convex, surface smooth, warted to coarsely warted, sometimes somewhat ridged with the edges of the crests whitish. Marginal areolae smooth to uneven but very rarely warted, subconvex or sometimes swollen-folded and lobe-like, of identical colour to that of central areolae except in greyish and mottled thalli where they tend to

be less mottled and to conserve better the brownish colour and the glossiness. Cortex 20-30(-40) μm , composed of anticlinally arranged hyphae terminated by brown pigmented caps, interspersed with small, $\pm$ elongated, brown crystals of lobaric acid dissolving in K (chemotypes I, II), minuscule, granulose colourless crystals of gyrophoric and lecanoric acids reacting C+ red with C (chemotype I, III) (both refringent under polarized light) or not interspersed (chemotype IV) (without refringence under polarized light); epinecral layer usually well developed, hyaline, of (5-)-10-15(-25) μm thick. Medulla white or dirty white, containing numerous lobaric (Chemotype I and II) and/or gyrophoric and lecanoric acid crystals (chemotype I and III) and of additional crystals of irregular shape and size which do not dissolve in K (chemotypes I, II, III and IV); algal layer, 60-100 μm , algal cells c. 10 μm in diam.

Apothecia usually scattered, rarely numerous and crowded, sometimes absent, lecanorine, immersed to adnate or sessile and constricted at the base, round to flexuose or subangular when crowded, (0.5-)-0.75-1.75(-2.5) mm in diam.; disc pale brown, chestnut brown to dark reddish brown, rarely brownish black, concave, plane to very convex, usually darker than the margin, epruinose, usually shiny; margin distinct, concolorous or darker than the thallus, thick, entire to crenulate, shiny, usually persistent, excluded only in very convex apothecia. Thalline exciple (50-)-100(-200) μm wide, with a well defined cortex similar to thalline one but overlain by a thinner epinecral layer, with a distinct medulla filled with algal cells. Proper exciple forming a thick cupular layer (cf. Miyawaki 1991, Henssen 1995) up to 100 μm thick below the hypothecium and of 30-60 μm at the epihymenium level, interspersed with elongated or granulose crystals which are refringent under polarized light (chemotypes I, II and III) or not so (chemotype IV). Epihymenium diffusely yellowish brown to dark brown, 20-30 μm thick, covered by a layer which is continuous with the epinecral layer of the thalline margin. Hymenium hyaline or yellowish, (50-)-60-70(-90) μm tall, $\pm$ interspersed with elongated or granulose crystals except in chemotype IV. Subhymenium usually distinct, c. 15-20 μm thick. Paraphyses firmly coherent in water, distinct in K, c. 2-2.5 μm thick, with slightly wider apices each covered by a swollen gelatinous "hood" that may or may not contain a brown cap, poorly branched. Hypothecium hyaline or pale yellow, up to 100 μm thick.

Asci clavate, 40-60 x 12-15 μm , $\pm$ *Lecanora*-type (cf. Hafellner 1984: 293), with an ocular chamber and a distinct non-amyloid apical cushion, 8-spored; **ascospores** hyaline, simple, oblong-ellipsoid to narrowly ellipsoid with rounded ends, thin walled, of (7.5-)-9.5-13(-16) x (2.5-)-3-4(-4.5) μm , with some very thin hyaline setae [2-3(-4-6)] at each end (according to Calatayud (1998) they are similar to those present in the spores of several lichenicolous fungi as *Lichenopeltella*).

Pycnidia always present, usually very abundant, immersed, ostiole dark brown to black, punctiform, in section globose to oblong, wall brown-pigmented only around the ostiole. Conidiophores of type VI (Vobis 1980); **conidia** pleurogenously formed, hyaline, simple, bacilliform, straight to slightly curved, from (5-)7-11(-14) $\times$ $\pm$ 1 μ m.

Chemistry. *Spot tests:* medulla Pd-, I-, K+ pale to dirty yellow, C- or C+ pink to red, KC- or KC+ red to violet, UV+ white, UV $\pm$ pale whitish or UV-; the brown pigment in the cortex, the pycnidial wall around the ostiole and the epihymenium reacts C+ fleeting bluish-grey followed by very pale pink, K+ yellowish-brown, KC+ grey, KCK+ pale brown, N+ fleeting dark blue followed by persistent reddish violet, NK+ pale reddish violet; NKC+ orange. This brown pigment is not described in Meyer & Printzen (2000). *Secondary metabolites:* lobaric acid (and several related substances), gyrophoric acid, lecanoric acid and several fatty acids. Traces of norstictic acid have sometimes been detected (present results, Sipman & Raus 1995, 1999). This is most probably due to other lichen species containing this substance that have been overgrown by *P. montagnei*.

Habitat and distribution. Given the synonymy of *P. montagnei* and *P. psarophana* established in the present study, *P. montagnei* loses its marked thermomediterranean character reported by Egea & Llimona (1987). It must now be considered a Mediterranean-Macaronesian species which is silicolous and rather heliophobous, growing from sea level to c. 1500 m altitude in the Canary Islands, Andalusia and north Africa to the last Mediterranean coastal enclave in Bulgaria (Vězda 1975). It also appears sporadically along the Atlantic coast of the Iberian Peninsula and reaches southern England.

In Eastern Iberian Peninsula, where it is locally abundant, *P. montagnei* occurs from the thermomediterranean to the mesomediterranean belt, from sea level, to littoral, pre-littoral or more inland mountains localities to 1300 m altitude. It grows on diverse, hard siliceous rocks (granitic, volcanic, schistose), on more exposed and sunny situations in inland and higher altitude locations.

The species is found in two well-differentiated groups of lichen communities on north facing siliceous rock surfaces (Table 1).

- (1) *Pertusarietum gallicae* on acid lava in Sierra del Cabo de Gata (Almería) (Egea & Llimona 1994).
- (2) The same community in volcanic outcrops and islands of Mar Menor (Murcia) (Llimona & Egea 1984).
- (3) The same community, on siliceous, non-volcanic lowland rocks in SE Spain (Egea & Llimona 1987).
- (4) *Pertusarietum rupestris*, in Filabres and Alhamilla ranges (Almería, 1000-1300 m), on siliceous rocks (Egea & Llimona 1987). Presence index (P): V: in 80-100 % of the relevés, IV: in 80-60 %, and so on. Coverage (R): average value, in % of the plot surfaces covered by the taxon. For more details about the adapted Klement's methodology of obtention and treatment of the relevés, see Egea & Llimona (1987, p. 16-20).

TABLE 1. Ecology of *Protoparmelia montagnei*, defined by the synthetic tables of three groups of releves from lower hills of SW Spain and a group of releves from two mountain ranges in the same region.

	<i>Pert. gallica</i> e		<i>Pert. gallica</i> e		<i>Pert. gallica</i> e		<i>Pert. rupestris</i>	
	Cabo de Gata 26 releves (1)		Mar Menor 19 releves (2)		Silic. non-volcan. 9 releves (3)		Filabres-Alhamilla 12 releves (4)	
	P	R	P	R	P	R	P	R
<i>Protoparmelia montagnei</i>	V	7,6	V	8,0	IV	5,8	III	5,2
<i>Lecanora schistina</i>	V	11,0	III	14,7	V	17,8		
<i>Pertusaria pluripuncta</i>	V	25,6	V	8,8	IV	16,7		
<i>Ramalina requienii</i>	IV	15,6	IV	6,5	III	2,2		
<i>Buellia tesserata</i>	IV	6,5	II	1,4	II	2,0		
<i>Buellia subdisciformis</i>	IV	1,1	III	4,5	IV	3,0	I	0,4
<i>Rinodina santorinensis</i>	II	4,0	III	6,7	IV	16,1		
<i>Pertusaria teneriffensis</i>	III	10,3	II	7,5				
<i>Rhizocarpon lusitanicum</i>	II	1,3			II	0,1		
<i>Ramalina clementeana</i>	III	2,7			II	0,6		
<i>Ramalina rosacea</i>	II	3,4	II	1,8				
<i>Rinodina alba</i>	II	0,8	II	1,1	II	0,3		
<i>Caloplaca scoriophila</i>	I	0,3	II	0,5				
<i>Pertusaria pertusa</i> var. <i>rupestris</i>							IV	12,1
<i>Parmelia tiliacea</i>							IV	9,2
<i>Lecanora rupicola</i>							III	3,1
<i>Pertusaria leucosora</i>							III	2,1
<i>Rhizocarpon distinctum</i>							III	1,5
<i>Lecidella carpathica</i>							III	2,3
<i>Anaptychia ciliaris</i>							III	0,8
<i>Physcia caesia</i> var. <i>caesiella</i>							III	0,3
<i>Physcia magnussonii</i>							II	2,9
<i>Aspicilia excipularis</i>							II	2,7
<i>Rinodina confragosa</i>							II	0,4
<i>Pertusaria pseudocorallina</i>							I	0,2
<i>Dimelaena oreina</i>							I	0,2
<i>Aspicilia intermutans</i>	IV	6,3	III	9,5	III	2,5	IV	7,9
<i>Candelariella vitellina</i>	IV	2,6	IV	3,4	IV	1,1	IV	0,7
<i>Xanthoria calcicola</i>	IV	4,7	V	6,9	II	0,6	III	0,1
<i>Caloplaca crenularia</i>	III	3,3	III	1,8	IV	4,2	II	2,7
<i>Tephromela atra</i>	III	2,4			I	1,7	III	3,9
<i>Neofuscelia pulla</i>	III	5,0	II	1,7	III	1,7	II	0,1
<i>Lecidella asema</i>	II	0,4	II	0,3	III	2,5	III	1,0
<i>Ochrolechia parella</i>	II	3,7					II	0,6
<i>Lecanora rupicola</i> var. <i>sulphurata</i>	II	1,1					III	3,1
<i>Lecanora sulphurea</i>	I	0,7	I	0,3	II	0,3	III	3,1
<i>Lecanora gangaleoides</i>	I	0,3	III	0,4	IV	0,1		
<i>Rhizocarpon geographicum</i>	I	0,6					IV	4,6
<i>Diploschistes actinostomus</i>			II	6,6	I	0,3		
<i>Lecidella elaeochromoides</i>					II	0,6		
<i>Lecanora rupicola</i> ssp. <i>subplanata</i>			I	1,0				
<i>Rinodina beccariana</i>			II	2,5				

The first group of communities, well documented from SE Spain (Llimona & Egea 1984, Egea & Llimona 1987, 1994) is characterized by the presence of markedly thermophilous species such as *Pertusaria pluripuncta*, *Lecanora schistina*, *Buellia tesserata*, *Rinodina santorinensis* and *Rhizocarpon lusitanicum*. This group of communities has been included in the alliance *Lecanorion montagnei* Llimona (Egea & Llimona 1987: 69). We propose to conserve this alliance with the same name. It exhibits its optimal development in the thermomediterranean bioclimatic stage, with scattered extensions to the coast at Cap de Creus, îles d'Hyères, Sardinia and North Africa.

The second group of communities where *Protoparmelia montagnei* is usually present is characterized by the presence of clearly less thermophilous species, such as *Pertusaria rupicola*, *P. pertusa* var. *rupestris*, *P. leucosora*, *P. monogona*, *P. pseudocorallina* and *Anaptychia runcinata*. Its centre of distribution is in the siliceous hills of Catalonia (NE Spain), at 50 to 700 m altitude. This second group of communities has been included in the alliance *Pertusarion leucosorae* Egea & Llimona (1987: 74), which we propose to conserve under the same name. It exhibits its optimal development in the mesomediterranean bioclimatic stage relatively close to the sea in most of the septentrional Mediterranean region.

A well-known group of silicolous species is shared by both groups of communities, namely *Aspicilia intermutans*, *Candelariella vitellina*, *Caloplaca crenularia*, *Ochrolechia parella*, *Lecidella asema*, *L. elaeochromoides* and *Tephromela atra*.

Description of the chemotypes

Chemotype I (*lobaric and gyrophoric acids*)

Figs. 3 & 4

Morphology. Thallus grey, cream or usually chestnut brown and glossy, sometimes very finely pruinose, warted to coarsely warted or subsquamulose, rarely mottled and dull. Apothecia becoming constricted sessile, with thick and persistent thalline margins and flat to subconvex, rarely very convex discs. Thalline and apothecial tissues interspersed with very small, brown, $\pm$ elongated crystals (lobaric acid) and minuscule granulate crystals of gyrophoric acid. Ascospores (8.5-)10-13.5(-16) $\times$ 3-4(-5) μ m (M= 11.6; 3.5 μ m; SD= 1.6; 0.4 μ m; n= 85). Conidia (6-)7.5-10.5(-14) $\times$ $\pm$ 1 μ m (M= 8.8 μ m; SD= 1.5 μ m; n= 113).

Chemistry. *Spot tests:* medulla C- or C+ pink to red, KC+ red to red violet to violet, UV-, UV $\pm$ pale whitish or UV+ white. Reactions with C, KC and UV vary depending on the concentration of gyrophoric acid. The higher the concentration the clearer are the results UV-, C+ and KC+. Lower concentration of gyrophoric acid can be detected in section under the microscope by the application of C (C+ red). *Secondary metabolites:* lobaric acid (major, very rarely minor), norlobaridone (minor or absent), gyrophoric acid (minor or very rarely major), unknown substance X (minor or absent), by TLC and

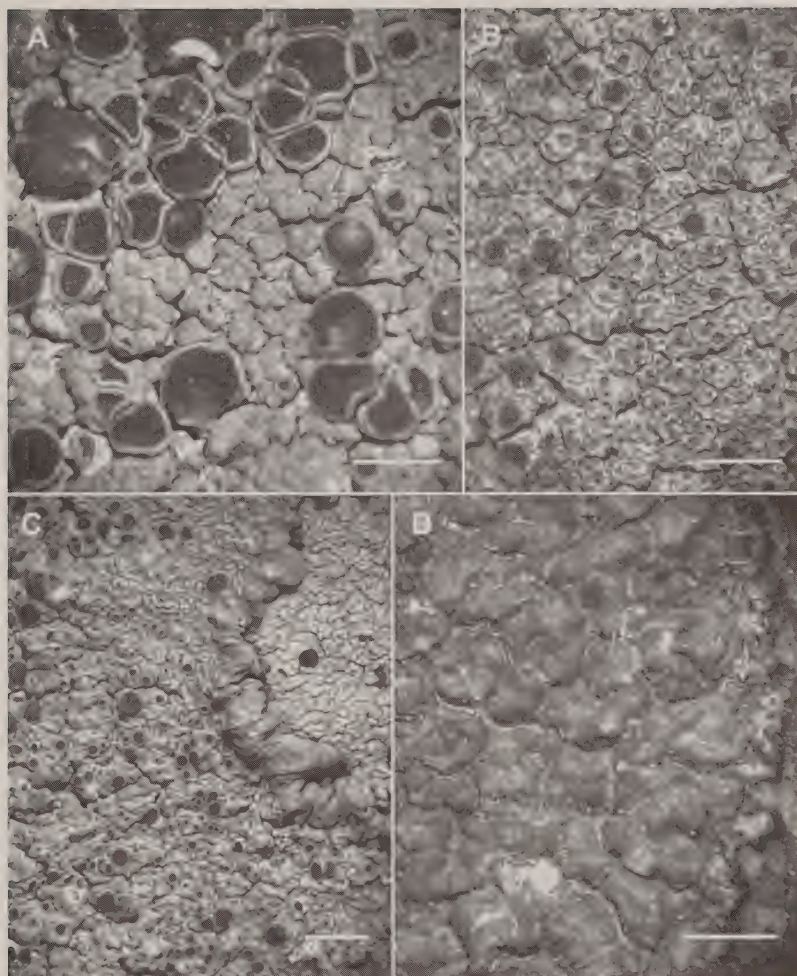


FIG. 1. Habit and thallus margin variability of *Protoparmelia montagnei*. A-D, Chemotype II. A, Warted areolae and sessile constricted apothecia of the *montagnei*-morphotype (BCC 13757); B, Uneven, mottled areolae and adnate apothecia of the *psarophana*-morphotype (Sipman 42840); C, Lobate thallus margin (BCC 13768); D, Non-lobate thallus margin delimited by a blackish hypothalline line (UPS 19666-Holotype). Scales: A, B & C = 2 mm; D = 1 mm.

HPLC. The unknown substance X (related to lobaric acid) is reported for the first time from this chemotype. When substance X is present it is visible under short wavelength ultraviolet light on TLC plates using the solvent systems A, B' and C (R_f classes 3/5/5).

Distribution. This is the most abundant and widespread chemotype in the study area and is especially abundant in southern and coastal localities. It occurs from sea level in coastal sites to 540 m altitude in littoral or pre-littoral mountains, where it can be accompanied by specimens of chemotype III. In one locality (Albacete) it occurs at an altitude of 1000-1100 m. It has also been reported from Menorca (Balearic Islands) (Lumbsch & Feige 1996), Provence (Ménard & Roux 1991), the south-eastern Aegean Islands (Sipman & Raus 2002) and the Channel Islands (Purvis et al. 1992).

Observations. The thallus morphology is not useful for identifying specimens belonging to this chemotype since most are very similar in habit to specimens belonging to chemotypes II and III. The most useful distinguishing character is the crystals of lobaric acid: being more abundant in chemotype II and absent in chemotype III. The lack of spot test reactions and cortical crystals readily distinguishes specimens of chemotype IV.

SELECTED SPECIMENS EXAMINED. SPAIN. Albacete: Alcaraz, REOLID, (30SWG3619), 1000-1100 m, pizarras y cuarcitas, 24 iii 1978, Egea (MUB 1201). Almería: Sierra del Cabo de Gata, PICO DEL FRAILE (30SWF8271), 400 m, andesita, 29 xii 1972, Llimona (BCC); Sierra del Cabo de Gata, CERRO DE SAN MIGUEL (30SWF7265), 340 m, andesita, 14 iv 1973, Llimona (BCC); Sierra del Cabo de Gata, COLLADO DE VELA BLANCA (30SWF7464), 200 m, andesita, 13 ix 1982, Egea (MUB 1269); Sierra del Cabo de Gata, EL MONSUL (30SWF7567), 120 m, andesita, 30 xii 1970, Llimona (BCC); Sierra del Cabo de Gata, CERRO CUEVAS (30SWF7968), 130 m, 19 iii 1972, Llimona (MUB 1511); Sierra Almagrera, Los Lobos, COLLADO DE LA CASA NUEVA (30SXG1128), 370 m, 6 iv 1977, Egea, (MUB 1207). Barcelona: Maresme, Òrrius, TURÓ DE SÈLLECS (31TDG4501), 534 m, 11 ii 1993 and 23 i 02, Barbero & Llimona (BCC, BCC 13780); Baix Llobregat, CASTELLVÍ DE ROSANES (31TDF0888), 400 m, 3 v 1997, Valverde (BCC). Murcia: Cabo de Palos, ISLA DEL CIERVO (30SXG9970), 46 m, andesitas ortopiroxénicas, 25 xi 1979, Llimona & Egea (MUB-8650, 1699); Cabo de Palos, ISLA GROSA (30SYG0278), 102 m, andesitas ortopiroxénicas, 8 iv 1978, Llimona & Egea (MUB 1701, 8644); Cabo de palos, CARMOLÍ (30SXG8973), 117 m, andesitas ortopiroxénicas, 12 iv 1973, Llimona & Egea and 17 v 1979, Egea (MUB 8647, 1698); Cabo de Palos, ISLA MAJOR, 30SXG9675, 100 m, 25 iii 1975, Llimona (MUB 1701); Cabo de Palos, ATALAYÓN (30SYG0165), 180 m, microesquistos y cuarcitas, 5 iv 1977, Egea (MUB 1206); Cabo de Palos, ISLA PERDIGUERA (30SXG9375), 46 m, 23 i 1981 and 4 iii 1984, Egea (MUB 1700, 3155).

Chemotype II (*lobaric acid*)

Figs. 1, 3 & 4

Morphology. The thallus morphology of this chemotype is very variable and includes specimens identical to those of chemotypes I, III or IV or intermediates between them. Thalline and apothecial false tissues are totally interspersed with the typical crystals of lobaric acid. Ascospores (7.5-)9.5-12(-14) x (2-)3-4(-4.5) μm (M= 10.5; 3.3 μm ; SD= 1.2; 0.5 μm ; n= 77). Conidia (5-)7-9.5(-13) x $\pm 1 \mu\text{m}$ (M= 8.2 μm ; SD= 1.3 μm ; n= 194).

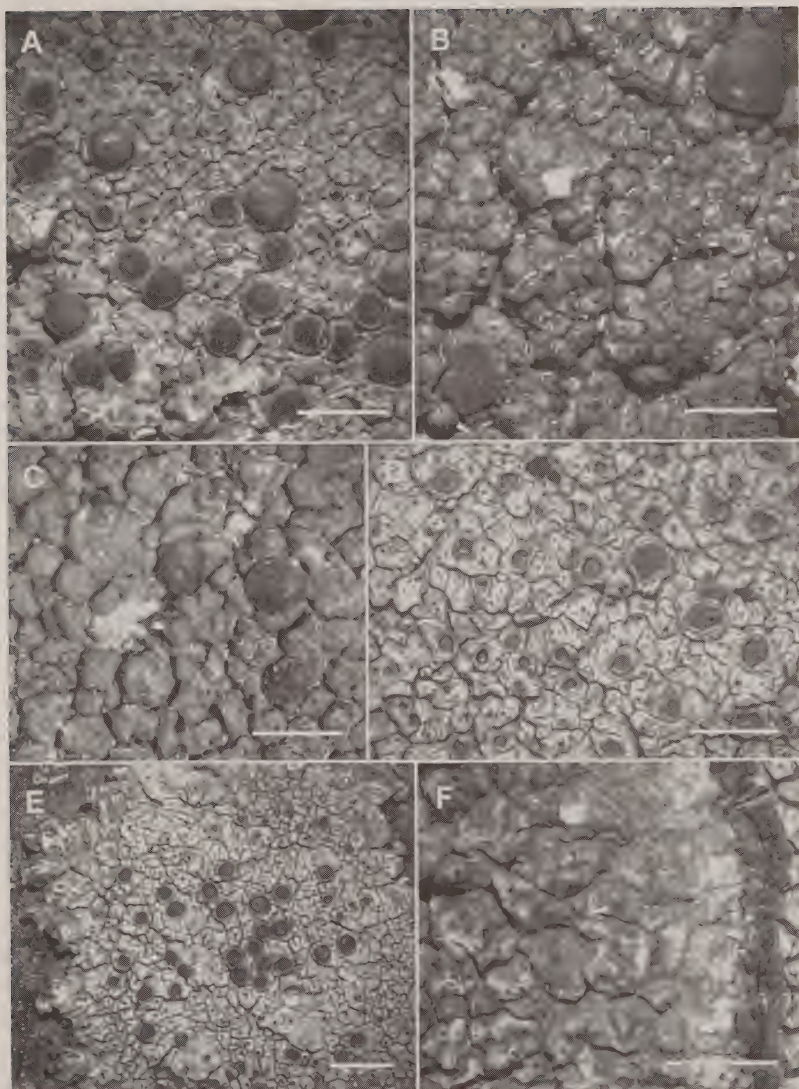


FIG. 2. Habit and thallus margin variability of *Protoparmelia montagnei*. A & B, Chemotype III. A, *psarophana*-morphotype (Hb. Roux-Holotype); B, *montagnei*-morphotype (Sipman 42529); C-F, Chemotype IV. C, *montagnei*-morphotype (1 iv 1972, Llimona); D, *psarophana*-morphotype (BCC 13772); E: Lobate thallus margin (BCC 13772); F: Non-lobate thallus margin with mottled areolae delimited by a black hypothalline line (BCC 13772). Scales = 2 mm.

Chemistry. *Spot tests:* medulla C-, KC+ violet, UV+ white. The KC+ violet reaction is always present but sometimes only by places. *Secondary metabolites:* lobaric acid (major), norlobaridone (minor or absent), unknown substance Y (minor or absent) and oxolobaric acid (trace or absent), by TLC and HPLC. Oxolobaric acid, norlobaridone and the unknown substance Y (related to lobaric acid) are reported for the first time from this chemotype. When substance Y is present it is visible under short wavelength ultraviolet light on TLC plates using the solvent systems A, B' and C (R_F classes 3/5/4).

Distribution. Chemotype II occurs from sea level in coastal localities to c. 400 m altitude in littoral or pre-littoral mountains, co-occurring with chemotype IV in northern localities (Cap de Creus). It is also known from several coastal sites at sea level in Provence (type locality of *P. montagnei*) growing together with chemotype I, III and IV (present results; Ménard & Roux 1991), Corsica (present results) and Sardinia (Kümmerling 1991), and from coastal and mountain sites up to 700 m in Paros and Antiparos (Greece) accompanied by chemotype III (present results; Sipman & Raus 1999). It has also been reported from Santorini and the south eastern Aegean Islands (Greece) (Sipman & Raus 1995, 2002), and the Channel Islands (Purvis et al. 1992).

Observations. This chemotype is readily distinguished by the C-, KC+ violet and UV+ white medullary reactions. Nevertheless, specimens of chemotype I with low concentration of gyrophoric acid may give the same results. The high density of lobaric acid crystals in all thalline and apothecial tissues is then diagnostic. This character enabled us to assign the type specimen of *P. montagnei* to this chemotype (TLC analysis was avoided because of the sparse material).

SELECTED SPECIMENS EXAMINED. SPAIN. **Almería:** Sierra del Cabo de Gata, HORTICHUELA (30SWF8581), 362 m, dacita, 17 iv 1981, Llimona (BCC); Sierra del Cabo de Gata, CORTIJO DE LOS LÓPEZ (30SWF7772), 330 m, andesita, 16 iv 1973, Llimona (BCC); Sierra del Cabo de Gata, Cerro de la Loma, entre RODALQUILAR y LAS NEGRAS (30SWF8680), 138 m, dacita, Llimona (BCC); Nijar, Serrata de Nijar, Repetidor de ATOCHARES (30SWF7581), 260 m, andesita, 12 ix 1975, Llimona (BCC). **Girona:** Cap de Creus, Cadaqués, RACÓ DE LA CLAVEGUERA (31TEG2686), 0-20 m, 13 ii 01, Llimona, Barbero & Gómez-Bolea (BCC 13755, 13757, 13766, 13768, 13769); Cap de Creus, Cadaqués, sota EL FAR (31TEG2686), 20-50 m, Llimona (MUB 1513).- **FRANCE.** **Corsica:** Ajaccio, SCOPULUS LA PARATA DICTUS, 10-20 m, on maritime granite rocks, 3 vii 1969, Lambinon, Rondon & Vězda (Vězda Lich. Sel Exs 812, BCC).- **GREECE.** **Cyclades Archipelago:** Antiparos, NW OF HAGIOS GEORGIOS (36°58.5'N, 25°01.5'E), 50 m, on schistose rock, 16 vi 1998, Sipman & Raus, Sipman 42840 (B); Antiparos, CAP KAVOS SKILOS, near Faneromeni chapel (36°56.5'N, 25°04.5'E), 5 m, on weathered volcanic rocks, 19 vi 1998, Sipman & Raus, Sipman 43134 (B); Antiparos, MT. AGIOS ILIAS, in center of island, near chapel (36°59.5'N, 25°03'E), 290 m, on schistose rocks, 19 vi 1998, Sipman & Raus, Sipman 43085 (B); Paros, KOLYMBITHRES, 2 km W of Naoussa, S-side of Mt. Vigla (37°07.5'N, 25°13'E), 25 m, on granitic rock, 12 vi 1998, Sipman

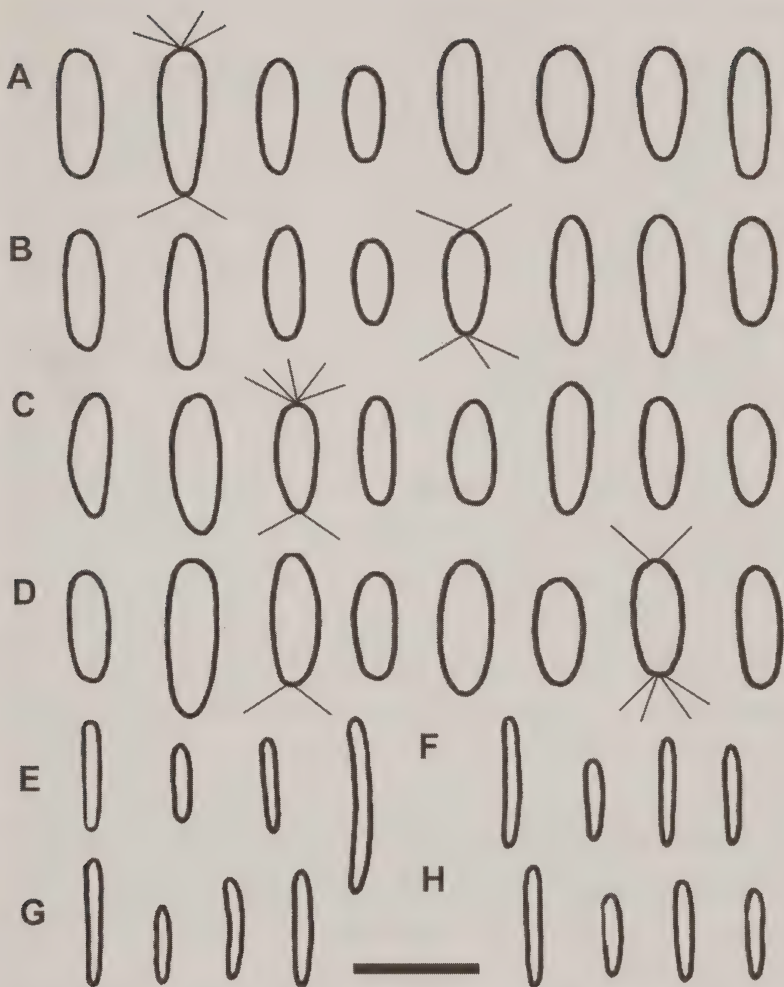


FIG. 3. Ascospores (some showing the apical hyaline setae) and conidia of *Protoparmelia montagnei*. A & E, Chemotype I (BCC 13780 & 29 xii 1972, Llimona); B & F, Chemotype II (BCC 13766 & Sipman 42525); C & G, Chemotype III (Sipman 43229 & 29 xii 1972, Llimona); D & H, Chemotype IV (BCC 13774 & VAB 2687). Scale = 10 μ m.

& Raus, Sipman 42525 (B); Paros, E-FLANK OF NT. AGIOS ANTONIOS, near Marpissa, 37°03'N, 25°16'E, 80 m, on volcanic rock, 14 vi 1998, Sipman & Raus, Sipman 42698 (B); Paros, MT. AGIOI PANTES (37°02'N, 25°11.5'E), 700m, on gneiss, 13 vi 1998, Sipman & Raus, Sipman 42631 (B).

Chemotype III (*Gyrophoric and lecanoric acids*)

Figs. 2, 3 & 4

Morphology. The thallus morphology of this chemotype is also very variable and includes specimens identical to those of chemotype I, II or IV or intermediates between them. The only distinguishing feature is the medullary chemistry. This can be recognized by the absence of the small brown $\pm$ elongated crystals of lobaric acid together with the presence of minute granulose crystals reacting C+ red (gyrophoric and lecanoric acids) in all thalline and apothecial false tissues. Ascospores (9-)10-13(-15) $\times$ (3-)3.5-4(-4.5) μm (M= 11.5; 3.8 μm ; SD= 1.5; 0.3 μm ; n= 54). Conidia (6-)8.5-10(-12.5) $\times$ 1 μm (M= 9.2 μm ; SD= 1 μm ; n= 104).

Chemistry. *Spot tests:* medulla C+ and KC+ red, UV-. *Secondary metabolites:* gyrophoric (major) and lecanoric (minor) acids, by TLC.

Distribution. This is the least frequent chemotype in the study area and occurs only in the southern locality, Cabo de Gata (Almería), growing at 300-400 m altitude in coastal mountains where it is accompanied by specimens of chemotype I. However, it does occur elsewhere at northern latitudes, in south-west England and south Wales (Purvis et al. 1992) and Provence (south-eastern France) (present results; Ménard & Roux 1991). It is also known from Paros and Antiparos (Greece) where it occurs from sea level to 700 m together with chemotype II (present results; Sipman & Raus 1999), and from Santorini and the south eastern Aegean Islands (Greece) (Sipman & Raus 1995, 2002).

Observations. The intense C+ red, KC+ red and UV- reactions readily distinguishes specimens belonging to chemotype III and they could only be confused with specimens of chemotype I with high concentrations of gyrophoric acid. In such cases, the absence of the typical lobaric acid crystals in apothecial and thalline tissue is diagnostic. We assume that the type specimen of *P. psarophana* var. *reagens* (not seen) belongs to this chemotype as established by Sipman & Raus (1999), and can confirm that *P. psarophana* var. *aquilina* is also a member of chemotype III. As a consequence, both are reduced to synonymy with *P. montagnei*.

SELECTED SPECIMENS EXAMINED. SPAIN. Almería: Sierra del Cabo de Gata, PICO DEL FRAILE (30SWF8271), 400 m, andesita, 29 xii 1972 and 23 iii 1972, Llimona (BCC); Sierra del Cabo de Gata, CERRO DE SAN MIGUEL (30SWF7265), 340 m, andesita, 14 iv 1973, Llimona (BCC).- FRANCE. Provence: Bouches-du-Rhône, la Ciotat, GOLFE DE FIGUEROLLES, sur apudmara krutajho NNW-orientigha, el turonia pudingo (shtonj el nekalka, kvarcita grejso; cementajho apenau kalka), 10 m, 10 vii 1976, Roux (Hb. Roux).- GREECE. Cyclades Archipelago: Antiparos, S-point of the island, CAP KAVOS SKILOS, near Faneromeni chapel (36°56.5'N, 25°04.5'E), 5 m, weathered volcanic rock, 19 vi 1998, Sipman & Raus, Sipman 43124 (B); Paros, KOLYMBITHRES, 2 km W of Naoussa, S-side of Mt. Vigla (37°07.5'N, 25°13'E), 25 m, on granitic rock, 12 vi 1998, Sipman & Raus, Sipman 42529 (B); Paros, MT. AGIOI PANTES, highest point of island,



FIG. 4. Distribution of *Protoparmelia montagnei* in the Iberian Peninsula. ● Chemotype I; △ Chemotype II; ▲ Chemotype III; ○ Chemotype IV; * Selected bibliographic data of *P. montagnei* of unknown chemotype.

S-side (37°02'N, 25°11.5'E), 700m, on gneiss, 22 vi 1998, Sipman & Raus, Sipman 43316 (B); Paros, BETWEEN LEFKES AND MT. AGIOI PANTES (37°02.5'N, 25°12.5'E), 450m, on gneiss, 15 vi 1998, Sipman & Raus, Sipman 42817 (B); Paros, HILL GORAKAS, 4 km NE of Paros-town (37°07.5'N, 25°11.5'E), 150-200 m, schistose rock, 21 vi 1998, Sipman & Raus, Sipman 43229 (B).

Chemotype IV (*chemosyndrome of fatty acids*)

Figs. 2, 3 & 4

Morphology. Thallus grey-brown to dark brown, with central areolae, usually ± mottled white due to a thick, ± eroded epinecral layer, flat, smooth to uneven but rarely strongly warted; marginal areolae less mottled, more glossy and chestnut brown. No crystals are present in the thalline and apothecial cortices. Apothecia immersed-urceolate to adnate, rarely sessile constricted, often becoming convex and with ± excluded thalline margins. Ascospores (9-)10.5-12.5(-14) x 3-4(-5) µm (M= 11.3; 3.6 µm; SD= 1; 0.4 µm; n= 67). Conidia (6-)8-10.5(-14) x ± 1 µm (M= 9.4 µm; SD= 1.3; n= 156).

Chemistry. *Spot tests:* medulla: C-, KC- UV-. *Secondary metabolites:* protoconstipatic acid (major), constipatic acid (major), dehydroconstipatic acid (minor), dehydroprotoconstipatic acid (minor) and an unknown fatty acid (major) by TLC and HPLC. Sometimes not all of these substances can be detected by TLC but they are reported for the first time for this species. Additional information on these secondary lichen substances are given in Chester & Elix (1979).

Distribution. This seems to be the more northerly, montane chemotype present in the study area. It occurs at sea level in northern coastal localities (Cap de Creus), where it grows together with chemotype II, to mid (300-600 m) or higher elevations (up to 1300 m) in the far south. It is also known from the Albères Mountains (Pyrénées-Orientales, including type locality of *P. psarophana*; present results) and from Provence (France) (Ménard & Roux 1991). Hitherto it has not been detected far south of València nor from Provence in the north-west.

Observations. The thallus morphology of this chemotype is rather homogenous, although some specimens are close to or intermediate between specimens belonging to other chemotypes. Nevertheless, the general habit as described above is not exclusive to this chemotype as it is also frequent in chemotypes II and III. The absence of C, KC and UV spot test reactions and of crystals in cortices, provide diagnostic characters for distinguishing this chemotype. The type specimen of *P. psarophana* var. *psarophana* belongs to this chemotype. Although TLC was not carried out in order to conserve type material, the lack of positive tests with C, KC and UV, the absence of crystals in cortices and the presence of 2 additional specimens belonging to chemotype IV in a site close to the type locality (H-Nyl. 25686 and 25691), confirmed that the type specimen is a member of this chemotype.

SELECTED SPECIMENS EXAMINED. SPAIN. Castelló: Pina de Montalgrao, STA. BÁRBARA (30SYK0233), 1300 m, arenisca ortocuarçítica, 12 x 1989, Calatayud, Atienza, Puche and 21 iii 1992, Calatayud (VAB 2687, 2629, 2630); Benicàssim, PARRETA ALTA (31TBE4538), 390 m, arenisca ortocuarçítica, 22 iv 1993, Calatayud (VAB 2948); Benicàssim, VILLA COMBA (30TBE4840), 300 m, arenisca ortocuarçítica 22 iv 1993, Calatayud (VAB 7037). **Girona:** Cap de Creus, Cadaqués, vora MAS DE RABASSERS DE BAIX (31TEG2486), 100 m, 18 v 1997, Llimona (BCC 13179, 13772, 13774, 13777); Cap de Creus, Cadaqués, RIERA DE JONQUET (31TEG2585), 30-50 m, 1 iv 1972, Llimona and 13 ii 2001, Llimona, Barbero & Gómez-Bolea (MUB 1506, BCC 13770); Cap de Creus, Cadaqués, Vora MAS DURÀN, sobre Port Lligat (31TEG2383), 100 m, 4 viii 1972, Wirth & Llimona (BCC); Cap de Creus, Cadaqués, Sant Salvador, sureda de SANT SEBASTIÀ (31TEG2181), 300 m, 1 iv 1972, Llimona (BCC); Cap de Creus, El Port de la Selva, sobre la CALA TAMARIUA, grans blocs d'esquist al costat del camí dels masos (31TEG1887), 100 m, 5 viii 1972, Llimona (BCC); El Port de la Selva, PUIG VAQUER (31TEG1488), 380-400 m, 27 viii 1974, Llimona (BCC); Cap de Creus, El Port de la

TABLE 2. Differential features of the four chemotypes of *Protoparmelia montagnei* in the eastern Iberian Peninsula (the ranges include frequent measurements and exclude extreme values; [M] = Mean value)

	Chemotype I (lobaric and gyrophoric)	Chemotype II (lobaric acid)	Chemotype III (gyrophoric and lecanoric)	Chemotype IV (fatty acids)
<i>psarophana</i> -morphotype	Absent	Frequent	Frequent	Dominant
<i>montagnei</i> -morphotype	Dominant	Dominant	Frequent	Absent
Deviating or intermediates morphotypes	Present	Present	Present	Present
Ascospore length and breadth & [M] (μm)	10-13.5 x 3-4 [11.6 x 3.5]	9.5-12 x 3-4 [10.5 x 3.3]	10-13 x 3.5-4 [11.5 x 3.8]	10.5-12.5 x 3-4 [11.3 x 3.6]
Conidia length & [M] (μm)	7.5-10.5 [8.8]	7-9.5 [8.2]	8.5-10 [9.2]	8-10.5 [9.4]
Tests in medulla	C+ red or C- KC+ red, KC+ red violet or KC+violet UV-, UV $\pm$ pale white or UV+ white	C- KC+violet (sometimes by places) UV+ white	C+ red KC+ red UV-	C- KC- UV-
Small, $\pm$ elongated, brown crystals of lobaric acid	Present; mainly in cortices	Very abundant; in cortices and apothecial false tissues	Absent	Absent

Selva, SERRA CARBONERA (31TEG1788), 125 m, 29 iii 1997, Llimona (BCC 13180); Cap de Creus, El Port de la Selva, ST. PERE DE RODA, 5 viii 1972, Llimona (BCC); Roses, vora la CREU DE'N COBERTELLA (31TEG1679), 50 m, 25 ii 1984, Llimona (BCC); Port Bou, QUERROIG (31TEG1098), 650 m, 12 viii 1975, Llimona (MUB 1514). València: Serra El Garbí, ESTIVELLA, 30SYJ2597, 575 m, arenisca ortocuarcítica, 15 iv 1992, Calatayud (VAB 2632, 2853).- FRANCE: Pyrénées-Orientales: FORÇA REAL, 400 m, 16 vii 1872, Nylander-25686, 25691 (H); TOUR DE LA MASSANE, 700 m, 16 vii. 1872, Nylander 25689 (H).

Discussion and conclusions

The type specimens of *Protoparmelia montagnei* and *P. psarophana* are macroscopically very similar. The main differences observed are in the colour and surface of the thallus and in the attachment of the apothecia. Thus the upper surface of *P. montagnei* is chesnut-glossy, composed of convex to warted areolae and having sessile, constricted apothecia. The upper surface of *P. psarophana* on the other hand is grey-brown, mottled and mat, being composed of flat to uneven areolae with adnate apothecia. Neither of the type specimens has marginal thalline lobes, which is a distinguishing character according to several authors. Furthermore, except for the presence/absence of crystals in cortices, the two type specimens are indistinguishable microscopically (Table 2, Fig. 3).

Among the specimens studied, we encountered various morphotypes including specimens which closely resemble the type of *P. montagnei* (*montagnei*-morphotype), specimens close to the type of *P. psarophana* (*psarophana*-morphotype) and intermediate specimens difficult to assign to either morphotype (Figs. 1 & 2).

As regards the chemistry, the type specimen of *P. montagnei* contains lobaric acid whereas that of *P. psarophana* a chemosyndrome of fatty acids (see above).

The specimens examined could be assigned to one of the following well characterized chemical races: (I) lobaric and gyrophoric acids; (II) lobaric acid; (III) gyrophoric and lecanoric acids; and (IV) chemosyndrome of fatty acids. Specimens belonging to the *montagnei*-morphotype, the *psarophana*-morphotype, or intermediate and divergent specimens, were represented in all chemotypes (compare Figs. 1 & 2, Table 1). Nevertheless, *montagnei*-morphotype was dominant in chemotype I and the *psarophana*-morphotype in chemotype IV. Chemotypes II and III are the most variable and included all morphotypes.

Consequently, we conclude that the differences in thalline growth habit are unrelated to thallus chemistry but are due to other factors such as microclimatic conditions, ageing processes, or the nature, surface or enrichment of the substrate. For instance, very young thalli overgrowing aged thalli have been observed in all morpho- and chemotypes. They always have the same appearance

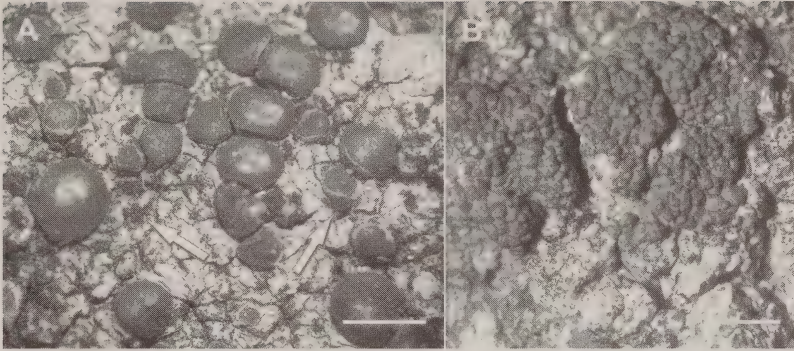


FIG. 5. A, The lichenicolous fungus cf. *Lichenothelia* sp. (arrows) overgrowing *P. montagnei* (5 viii 1972, Llimona); B, Two young thalli of *Protaparmelia montagnei* of typical *montagnei*-morphotype overgrowing a 'parent' thallus of the *psarophana*-morphotype (25 ii 1984, Llimona). Scales: 2 mm.

(close to the *montagnei*-morphotype) but are concordant with the chemistry of the 'parent' thallus (verified through the spot tests) (Fig. 5B). In *Dimelaena oreina* (Calatayud & Rico 1999) the variations in thickness and sublobulation of the thallus and in the prominence of the apothecia and thalline margins may be caused by substrate eutrophication from marine bird depositions, and similar circumstances may prevail here.

We consider that the different morpho- and chemotypes observed are variations within a single species and have concluded that *P. montagnei* and *P. psarophana* are conspecific. In particular, because: (1) the macroscopic differences observed between *montagnei*-morphotype and the *psarophana*-morphotype are too subtle and are inconsistent; (2) the presence of intermediate and deviant morphotypes among the specimens studied; (3) the absence of additional characters such as ascospore and conidia shape and size, characters frequently used to separate species of *Protaparmelia*; and (4) the lack of any correlation between morphological and chemical characters.

Furthermore, the lichenicolous fungus cf. *Lichenothelia* sp. (currently being studied) has been found growing on all morpho- and chemotypes without any discrimination (Fig. 5A).

Nevertheless, the four chemotypes do exhibit different ecological and distributional preferences within the study area. Whereas chemotype I is the most abundant and widespread, chemotype II is only locally abundant in extreme southern (Cabo de Gata) and northern (Cap de Creus) localities. Both chemotypes range from sea level in coastal sites to mid altitudes in hinterland mountains. In the study area chemotype III occurs only in the southern localities (Cabo de Gata) at mid altitudes in coastal mountains, but elsewhere

it is abundant at more northerly latitudes (in south-eastern France, south-west England and south Wales). Chemotype IV is most abundant in montane, northerly locations, although it also grows at sea level in northern localities (Fig. 4).

Finally, we want to comment on the presence of several setae at the ends of the ascospores of *P. montagnei*. This character, together with the presence/absence of a cupular exciple, conidia-, coniophores- and ascus-types, clearly separate the species of *P. badia* group (incl. *P. montagnei*) from those of *P. atriseda* group, thus confirming that the genus *Protoparmelia* is heterogeneous (Rambold 1989, Poelt & Leuckert 1991, Poelt & Grube 1992) and of uncertain taxonomic position within the *Lecanoraceae* (e.g. Ryan et al. 2005) or the *Parmeliaceae* (e.g. Miyawaki 1991, Henssen 1995, Kirk et al. 2001).

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Three new Chinese records of *Phyllachora* (Phyllachorales)

NA LIU^{1,2} & LIN GUO^{1*}

liuna3456@163.com *guol@sun.im.ac.cn

¹Key Laboratory of Systematic Mycology and Lichenology
Institute of Microbiology, Chinese Academy of Sciences
Beijing 100080, China

²Graduate University of Chinese Academy of Sciences
Beijing 100049, China

Abstract—Three new Chinese records of *Phyllachora* are reported: *Phyllachora ehrhartae* on *Poa* sp., *Phyllachora paspalicola* on *Isachne tenuis* and *Phyllachora fimbristylidicola* on *Fimbristylis dichotoma*. These specimens were collected from Gansu and Yunnan Provinces.

Key words—*Sordariomycetidae*, tar spot, taxonomy

Introduction

The first report of *Phyllachora* in China was by Kalchbrenner & Thümen (1881) who listed *Phyllachora angelicae* (Fr.) Fuckel collected from Inner Mongolia. Yates (1917) reported some *Phyllachora* species collected from southern China. Sydow & Sydow (1920) also reported some *Phyllachora* species from southern China and described a new species: *Phyllachora cantonensis* Syd. & P. Syd. Sawada (1919, 1928, 1943, 1944, 1959) reported some new species from Taiwan. In the following years, many foreign and Chinese scientists reported the distributions of *Phyllachora* in China (Tai 1979). Luo (1984) made a detailed study about *Phyllachora* inhabiting *Poaceae*. Wang et al. (1991) listed all *Phyllachora* species from Taiwan. Recently, Zhang et al. (2003, 2005) and Qin et al. (2003) reported some new Chinese records. So far, about 82 species have been reported in China, including 55 species on *Poaceae* and 2 species on *Cyperaceae*.

Phyllachora on *Poa*

There are five taxa reported on *Poa*: 1) *Phyllachora antarctica* Speg. with ellipsoid to ovoid ascospores measuring 12–14 x 6–8 µm (Trotter 1972); 2) *Phyllachora bromi* Fuckel with globose to ovoid ascospores measuring 12–14 x 7–8 µm

*corresponding author

(Saccardo 1883); 3) *Phyllachora graminis* (Pers.) Fuckel [syn. *Phyllachora poae* (Fuckel) Sacc. (Saccardo 1883)] with ovoid ascospores measuring $7\text{--}14 \times 4\text{--}7 \mu\text{m}$; 4) *Phyllachora sylvatica* Sacc. & Speg. with ovoid, ellipsoid or semiellipsoid ascospores measuring $12\text{--}22 \times 4.5\text{--}8 \mu\text{m}$ (Parbery 1967) and 5) *Phyllachora scanica* Starbäck (Parbery 1967) with broadly ovoid to ellipsoid ascospores measuring $11\text{--}14 \times 6\text{--}7 \mu\text{m}$. The type of *Phyllachora ehrhartae* is parasitic on *Ehrharta erecta* Lam. with subglobose to broadly oval ascospores measuring $6.5\text{--}13 \times 5\text{--}6.5 \mu\text{m}$ from South Africa. The specimen collected by us is identified as *Phyllachora ehrhartae* based on the size and shape of ascospores and the length of asci.

Phyllachora ehrhartae Marasas, Bothalia 9: 208, 1966.

Figs. 1-2

Leaf spot: blackened regions sparse, rarely aggregated, long ellipsoidal, $0.7\text{--}2.3 \times 0.3\text{--}0.8 \text{ mm}$, shining black, rising from the upper leaf surface, multi-loculate, the ostiole inconspicuous, blackened regions can be visible from both sides of the leaves.

Anamorph: not seen.

Teleomorph: ascomata $115\text{--}240 \times 140\text{--}250 \mu\text{m}$, epigenous, immersed in the mesophyll layer of the leaves, subglobose or ellipsoidal, with well-developed, hyaline periphyses, asci rising from the basal and lateral wall of the ascoma. Upper wall up to $48 \mu\text{m}$ thick, composed of epidermis cells which are occluded by melanized material. Lower wall up to $45 \mu\text{m}$ thick. Lateral wall up to $30 \mu\text{m}$ thick. Paraphyses $1.5\text{--}2 \mu\text{m}$ wide, tapering, thin-walled, septate. Asci $68\text{--}93 \times 8.5\text{--}10 \mu\text{m}$, with a apical ring, 8-spored, clavate, short pedunculate, thin-walled at maturity, unitunicate. Ascospores arranged uniseriate, $5\text{--}13 \times 4\text{--}6.3 \mu\text{m}$, subglobose, oval, one-celled, hyaline, smooth, without a gelatinous sheath.

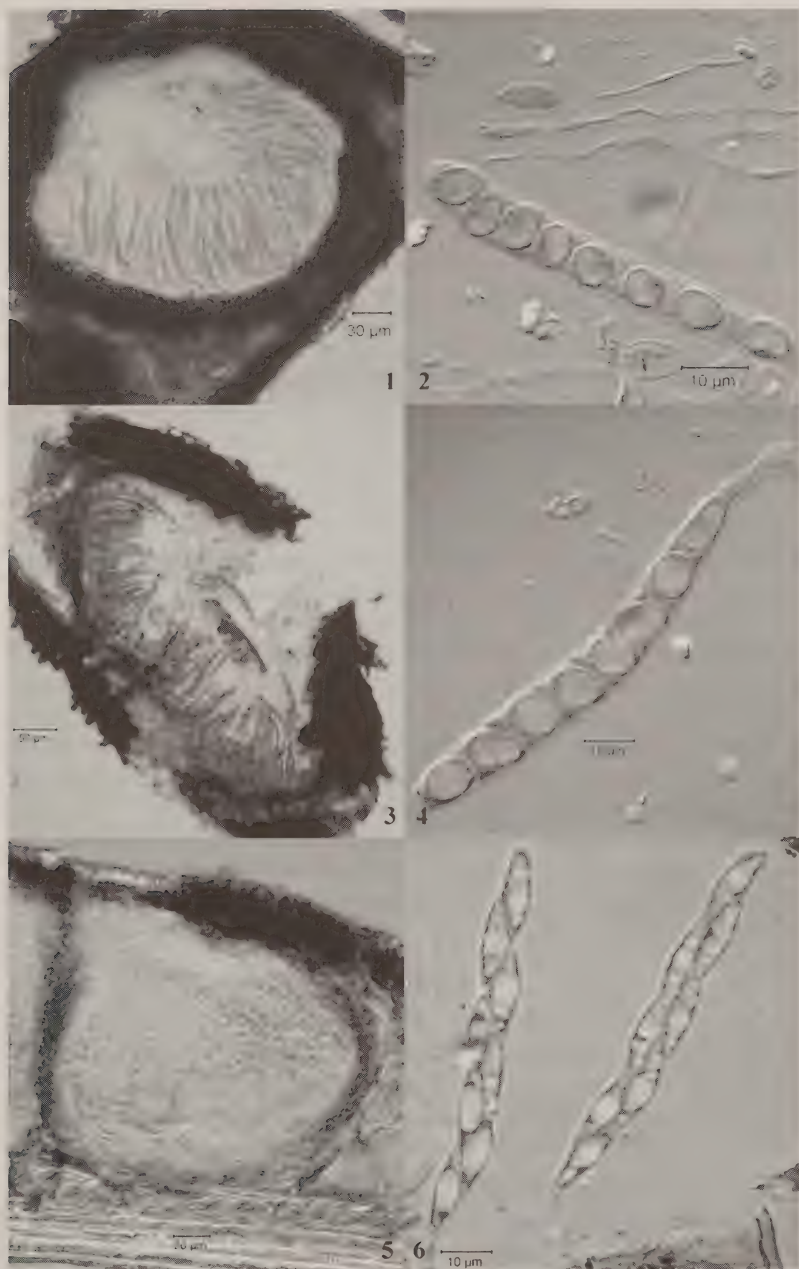
On leaves of *Poa* sp. (*Poaceae*), Gansu: Hezheng, Taizi Mountain, alt. 2560 m, 17 VI 2005, N. Liu, Z.Y. Li & L. Guo 21, HMAS 143656.

Until now, only *Phyllachora bromi* and *Phyllachora sylvatica*, have been reported on *Poa* in China. *Phyllachora ehrhartae* is reported here on *Poa* for the first time.

Phyllachora on Isachnes

Sawada (1959) reported *Phyllachora isachnes* Sawada on *Isachne debilis* Rendle with fusoid ascospores measuring $14\text{--}17 \times 3\text{--}4 \mu\text{m}$. Parbery (1967) considered

Figs. 1-2. *Phyllachora ehrhartae* on *Poa* sp. (HMAS 143656). Fig. 1. Section through immersed ascoma. Fig. 2. Differential interference micrograph of ascus and ascospores. Figs. 3-4. *Phyllachora paspalicola* on *Isachne tenuis* (HMAS 143934). Fig. 3. Section through immersed ascoma. Fig. 4. Differential interference micrograph of ascus and ascospores. Figs. 5-6. *Phyllachora fimbristylidicola* on *Fimbristylis dichotoma* (HMAS 135468). Fig. 5. Section through immersed ascoma. Fig. 6. Differential interference micrograph of asci and ascospores.



the species a synonym of *Phyllachora urvilleana* Speg. with fusoid ascospores measuring 18–20 x 4–7 μm . The fusoid ascospores are very different from our specimen. The type of *Phyllachora paspalicola* is on *Paspalum* sp. According to Parbery (1967), the species was also parasitic on *Isachne australis* R. Br. and had a wider geographic distribution. The recently collected specimen on *Isachne* is identified as *Phyllachora paspalicola* because it has the same shape and size of ascospores.

Phyllachora paspalicola Henn., Hedwigia 48: 106, 1908.

Figs. 3–4

=*Phyllachora winkleri* Syd. & P. Syd., Ann. Mycol. 10: 80, 1912.

=*Phyllachora exigua* Theiss. & Syd., Ann. Mycol. 13: 449, 1915.

=*Phyllachora ophiuri* Syd. & P. Syd., Ann. Mycol. 15: 226, 1917.

=*Phyllachora digitariae* Syd., Bothalia 1: 220, 1924.

=*Phyllachora chardonii* Orton, Sci. Surv. Porto Rico & Virgin Island 8: 51, 1926.

=*Phyllachora parilis* Syd., Ann. Mycol. 25: 3, 1927.

=*Phyllachora insularis* Chardón, J. Dept. Agric. Porto Rico 13: 13, 1929.

=*Phyllachora vaginata* Chardón, J. Dept. Agric. Porto Rico 16: 172, 1932.

=*Phyllachora wilsonii* Orton, Mycologia 36: 33, 1944.

Leaf spot: the included leaves becoming yellow. Blackened regions aggregated, roughly circular, 0.5–1.5 x 0.3–0.7 mm, shining black, rising from the upper leaf surface, 1- to 3-luculate, the ostiole inconspicuous, blackened regions can be visible from both sides of the leaves.

Anamorph: not seen.

Teleomorph: ascomata 85–250 x 140–475 μm , epigenous, immersed in the mesophyll layer of the leaves, ellipsoidal, with neck extending through the host epidermis and cuticle layer to the surface, with well-developed, hyaline periphyses, asci rising from the basal and lateral wall of the ascoma. Upper wall up to 90 μm thick, becoming thicker around the ostioles, composed of epidermis cells which are occluded by melanized material. Lower wall up to 40 μm thick. Lateral wall up to 22 μm thick, composed of thin-walled cells. Paraphyses 2 μm wide, filiform, longer than asci, thin-walled, aseptate. Asci 70–120 x 9–15 μm , 8-spored, cylindric, short pedunculate, thin-walled at maturity, unitunicate. Ascospores arranged uniseriate, 8–15 x 5–8.5 μm , ovoid, broadly ellipsoid or subglobose, guttulate, one-celled, hyaline, smooth, without a gelatinous sheath.

On living leaves of *Isachne tenuis* Keng f. (*Poaceae*), Yunnan: Tengchong, Xiaodifang, alt. 2100 m, 19 IX 2005, N. Liu, Z.Y. Li & L. Guo 131, HMAS 143934.

So far, there are two species, *Phyllachora urvilleana* and *Phyllachora paspalicola*, that have been reported on *Isachne* in China.

Phyllachora on *Fimbristylis*

Two species have been recognized on *Fimbristylis*: 1) *Phyllachora fimbristylidis* (Berk. & Broome) Sacc. [Saccardo 1891; syn. *Phyllachora fimbristylidis* Sawada (Sawada 1943, Tai 1979)] with fusiform ascospores measuring 17–18 x 2–3 µm; 2) *Phyllachora fimbristylidicola* with subfusoid ascospores measuring 14–20 x 4–6 µm (Saccardo & Trotter 1913). By comparing the size and shape of ascospores, the recently collected specimen was identified as *Phyllachora fimbristylidicola*. It is new to China.

Phyllachora fimbristylidicola Speg., Anal. Mus. Nac. Buenos Aires 19: 417, 1909, as '*fimbristylicola*'. Figs. 5-6

Leaf spot: blackened regions sparsely, roughly circular or ellipsoidal, 0.5–2.5×0.3–1 mm, shining black, rising from the surface, mainly visible on upper surface of the leaf, 1- to 2-loculate.

Anamorph: not seen.

Teleomorph: ascomata 100–200×125–350 µm, epigenous, immersed in upper epidermal layer of the leaves, subglobose or ellipsoidal, with flattened base, neck extending through the host cuticle layer to the surface, with well-developed, hyaline periphyses. Upper wall to 42 µm thick. Lateral wall to 25 µm thick, composed of thin-walled hyaline host cells and hyphae. Paraphyses 2 µm wide, thin-walled, septate, no branch. Asci 65–88×6–8 µm, 8-spored, cylindric, acute at apex, short pedunculate, thin-walled at maturity, unitunicate, with an inconspicuous apical ring. Ascospores arranged uniseriate or biseriate, 10–18×4–6.3 µm, fusoid or narrowly ellipsoid, one-celled, hyaline, guttulate, smooth.

On living leaves of *Fimbristylis dichotoma* (L.) Vahl (*Cyperaceae*), Yunnan: Tengchong, alt. 1600 m, 20 IX 2005, N. Liu, Z.Y. Li & L. Guo 145, HMAS 135468.

So far, three species have been reported on *Cyperaceae* in China: *Phyllachora fimbristylidis* and *Phyllachora fimbristylidicola* on *Fimbristylis*, and *Phyllachora marisci-sieberiani* Sawada ex Z.Y. Zhang & X.X. Zeng on *Mariscus*.

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Proposed synonyms in *Cyathus*

RUI-LIN ZHAO^{1,2,3}, DENNIS E. DESJARDIN^{4*},
KASEM SOYTONG¹ & KEVIN D. HYDE⁵

ded@sfsu.edu

¹ Department of Plant Pest Management, Faculty of Agricultural Technology
King Mongkut's Institute of Technology Ladkrabang (KMITL)
Ladkrabang, Bangkok 10520, Thailand

² Mushroom Research Foundation
128 Moo3, Bahn Pha Deng, T. Pa Pae, A. Mae Taeng
Chiang Mai 50150, Thailand

³ Faculty of Conservation Biology, Southwest Forestry College
Kunming, Yunnan Province 650224, PR China

⁴ Department of Biology, San Francisco State University
San Francisco, California, USA

⁵ Centre for Research in Fungal Diversity, Department of Ecology & Biodiversity
The University of Hong Kong, SAR PR China

Abstract—Based on the morphological analyses of 48 taxa of *Cyathus*, including 30 type specimens, three *Cyathus* species were found to represent synonyms of existing species. *Cyathus cheliensis*, *C. gansuensis* and *C. megasporus* are herein accepted as synonyms of *C. limbatus*, *C. pygmaeus* and *C. poeppigii*, respectively. The latter three species are redescribed and illustrated.

Key words—bird's nest fungi, *Nidulariaceae*, taxonomy

Introduction

The genus *Cyathus* (*Nidulariaceae*, *Nidulariales*) was established by Haller in 1768. The first monograph on *Cyathus* was published by Lloyd (1906), and later Brodie (1975, 1984) published two monographs on Bird's Nest Fungi wherein he included four genera (*Crucibulum* Tul. & C. Tul., *Cyathus* Haller, *Nidula* V.S. White and *Nidularia* Fr.) and forty nine species of *Cyathus*. Although Brodie's monographs have been followed by most mycologists, some *Cyathus* species in his monographs are questionable, because he did not examine all type specimens. In addition, since the last monograph of Brodie was published in 1984, twenty two additional species of *Cyathus* and five varieties have been published, many of which await critical comparisons with extant type specimens.

A systematic study of the genus *Cyathus* was conducted using morphological and molecular approaches (molecular phylogenies will be published elsewhere). The morphological analyses revealed that three recently described *Cyathus* species represent synonyms of older epithets. Although attempts were made to sequence all six taxa referred to in this paper, we were unsuccessful in obtaining useful sequences for *C. megasporus*, *C. limbatus* and *C. pygmaeus*. Our taxonomic conclusions are therefore based on data obtained from examinations of holotype specimens and authentic specimens identified by Brodie.

Materials and Methods

One hundred and fifteen specimens representing forth eight species of *Cyathus*, included thirty type specimens, were borrowed from five herbaria (BPI, DAOM, HMAS, MICH and SWFC; Holmgren & Holmgren 1998) and examined critically following Brodie's (1975) protocols. Pertinent data on peridia and peridiole features, and basidiospore size and shape were documented. A minimum of twenty basidiospores were measured per specimen.

Taxonomy

Cyathus limbatus Tul. & C. Tul., Ann. Sci. Nat., Bot. III, 1: 78, 1844. **Figure 1**
= *Cyathus cheliensis* F.L. Tai & Hung, Sci. Rep. Nat. Tsing Hua Univ. B, 3: 161,
1948.

Fruiting bodies obconical, mostly incurved at the mouth, constricting abruptly at the base, 6-10 mm high, 5-7 mm wide at mouth; exterior surface of peridium brown, reddish-brown or dark brown, some appearing lighter in color after the hairs are rubbed off; hairs congregated into tufts, appearing hirsute; plications distinct; interior surface of peridium mostly grey, sometimes brownish-grey to dark grey, distinctly striate; lip fimbriate, dark brown; base usually attached to the substrate by a conspicuous mass of mycelia. *Peridioles* mostly circular or subcircular in face view, sometimes broadly ellipsoid, 1.5-2.5 mm diam., with double cortexes 80-100 μ m thick, without a tunica. *Basidiospores* hyaline, smooth, ellipsoid to broadly ellipsoid, both ends rounded, thick-walled, 17-23 x 11-14 (-16) μ m.

Habit: gregarious on dead wood.

Known distribution: widely distributed in warm countries. Africa, British Guiana (type origin), China, Hawaiian Islands, India, Pacific Island, South America, Thailand, West Indies.

Material examined: One specimen of *C. cheliensis*: CHINA, Yunnan Province, Jinhong, 1939, H.S. Yao, HMAS 02755 (**Holotype**). Eight specimens of *C. limbatus*: CHINA, Yunnan Province, 11 Sept. 1994, T. X. Zhou, SWFC 20009; Congo, Katanga, 24 Nov. 1960, Schmitz Lavecque, DAOM 200492 (identified by Brodie); place unknown, 1899,

collector unknown, DAOM 200494 (identified by Brodie); JAMAICA, Wedcombe, 3 Sept. 1955, D.A. Powell, BPI 727165 (identified by Brodie); JAMAICA, Kingston, 14 Jan. 1966, H. J. Brodie, BPI 727167 (identified by Brodie); KENYA, Naisafi, Nov. 1953, R. M. Nattiaes, DAOM 200496 (identified by Brodie); UGANDA, time unknown, R. A. Dummer, BPI 727166 (identified by Brodie); USA, Kansas, Neola, 29 Aug. 1956, collector unknown, DAOM 200493 (identified by Brodie).

Notes: *Cyathus limbatus* is characterized by the following combination of features: darkly pigmented fruiting bodies with distinct plications on both peridial surfaces; mouths that are mostly incurved; thick and double cortexes on peridioles; and ellipsoid spores that measure “ $15 \times 10 \mu\text{m}$ in the type, but $16\text{--}22 \times 10\text{--}12 \mu\text{m}$ in other collections” (Brodie 1975). Morphological analyses of seven specimens identified by Brodie and of the holotype specimen of *C. cheliensis* indicated that the two taxa are anatomically indistinguishable (See Table 1). We therefore consider *C. cheliensis* to represent a synonym of *C. limbatus*.

Table 1. The comparison of mainly morphological characters between *Cyathus limbatus* and its synonym *Cyathus cheliensis*

Characters	<i>C. limbatus</i>	<i>C. cheliensis</i>
Shape of fruiting bodies	Obconic, base abruptly constrict, some mouth incurved	Obconic, broadly obconic, base abruptly constrict
Size of fruiting bodies	6-10 $\times$ 5-7 mm	7-9 $\times$ 7-8 mm
Color of exterior surface of peridium	Brown, reddish brown, dark brown	Russet, reddish brown, brown
Hairs on peridium	Gathered into tufts, hirsute	Gathered into tufts
Plications on peridium	Distinct at exterior and inner surfaces	Distinct at exterior and inner surfaces
Lip of fruiting bodies	fimbriate	fimbriate
Size of peridioles	1.5-2.5 mm in diam.	1.5-1.8 mm in diam.
Structure of peridioles	Double cortexes	Double cortexes
Shape of basidiospores	Ellipsoid, broadly ellipsoid, both ends round	Ellipsoid, broadly ellipsoid, both ends rounded
Size of basidiospores	17-23 $\times$ 11-14 (-16) μm	15-20 $\times$ 7.8-12.5 μm
Materials source	7 specimens identified by Brodie	Holotype

Tai (1979) omitted structural characters of the peridioles in his description of *C. cheliensis*, which is one of the crucial characters for the determination of *Cyathus* species. *Cyathus olivaceobrunneus* was the only species that was compared with *C. cheliensis* by Tai (1979), which differed from *C. cheliensis* in having lighter colored fruiting bodies, a smooth lip and smaller spores. Affinities of *Cyathus limbatus* to *C. cheliensis* were not addressed by Tai (1979).

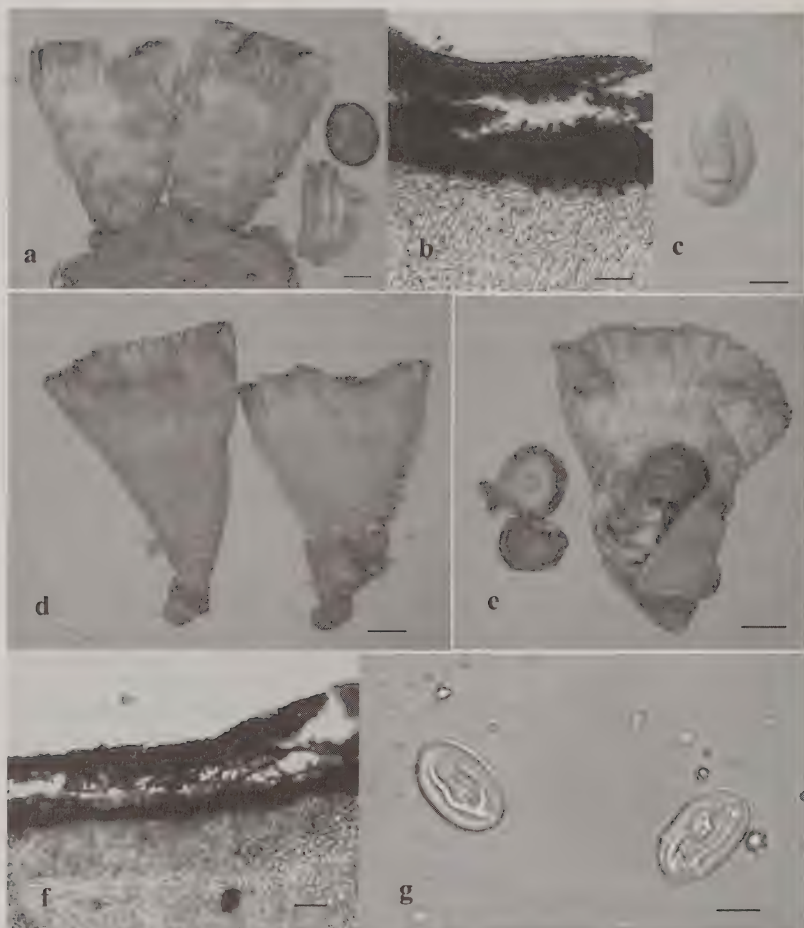


FIGURE 1. Comparison between a-c [*Cyathus limbatus* (DAOM 200496, identified by Brodie)] and proposed synonym d-g [*Cyathus cheliensis* (HMAS 02755 Holotype)]. a, d, e—Fruiting bodies, bars = 2 mm; b & f—Section of peridioles, double cortex, bars = 25 μm; c & g—Basidiospores, bars = 5 μm.

Cyathus pygmaeus Lloyd, Mycological Writings 2, The *Nidulariaceae*: 26, 1906.

Figure 2

= *Cyathus gansuensis* B. Yang, J. Yu & T.X. Zhou, Mycosystema 21:313, 2002.

Fruiting bodies variable in shape, obconical with a slender, short stipe or crucible-shaped without a distinct stipe, 3.5-5 mm high, 4-5 mm wide at the straight mouth; exterior surface of peridium light brown, lacking placations,

with hairs soft, short, aggregated into tufts, apex of tufts bleached, felt-like; interior surface of peridium dark gray, smooth, lacking plications; lip smooth; attached to the substrate without a conspicuous mass of mycelia. *Peridioles* circular to broadly ellipsoid, dark grey, 0.8-1.2 mm diam., with a single cortex 16-24 μm thick, and a tunica 16-20 μm thick. *Basidiospores* hyaline, smooth, broadly ellipsoid to ovoid, 11-15(-16) $\times$ 8-10 μm .

Habit: gregarious on dead twigs.

Known distribution: Chile, China, USA, typically found in arid habitats.

Material examined: Three specimens of *C. pygmaeus*: CHILE, Santiago, collection time unknown, M. R. Espinosa, BPI 703513 (identified by Lloyd); USA, California, collection time unknown, Stewart S. Towne, BPI 703515 (identified by Lloyd); USA, Washington, June 1909, J. S. Cotton, BPI 703514 (**Holotype**). One specimen of *C. gansuensis*: CHINA, Gansu Province, Xinglongshan Mountain, 1999, L.Z. Zhao, SWFC 20880 (**Holotype**).

Table 2. The comparison of mainly morphological characters between *Cyathus pygmaeus* and its synonym *Cyathus gansuensis*

Characters	<i>C. pygmaeus</i>	<i>C. gansuensis</i>
Shape of fruiting bodies	Obconic with slender, short stipe or crucible-shaped without distinct stipe	Obconic, abruptly constricted at the base
Size of fruiting bodies	3.5-5 $\times$ 4-5 mm	2-7 $\times$ 4-8 mm
Color of exterior surface of peridium	Light brown	Brown, grayish brown
Color of interior surface of peridium	Dark brown	Dark brown
Hairs on peridium	Tufts aggregated by thick tomenta	Tufts aggregated by tomenta
Plications on peridium	No plications	No plications
Lip of fruiting bodies	Smooth	Smooth
Size of peridioles	0.8-1 mm in diameter	1-1.5 mm in diameter
Structure of peridioles	Single cortex with tunica	Single cortex with tunica
Shape of basidiospores	Broad ellipsoid, ovoid	Ovoid, broadly ellipsoid
Size of basidiospores	12-15 (-16) $\times$ 8-10 μm	10-13 $\times$ 7.5-10 μm
Materials source	Holotype and 2 specimens identified by Lloyd	Holotype

Notes: *Cyathus pygmaeus* is one of the smallest known *Cyathus* species in terms of fruiting body size. Brodie (1975) stated that three other characters should be used to distinguish *C. pygmaeus* from similar taxa: i) flared rim of fruiting bodies; ii) very dark interior of the cup; and iii) the white, durable epiphragm. Examination of the holotype of *C. pygmaeus* showed that fruiting bodies did not have flared mouths, although a second specimen, BPI 703515 identified by

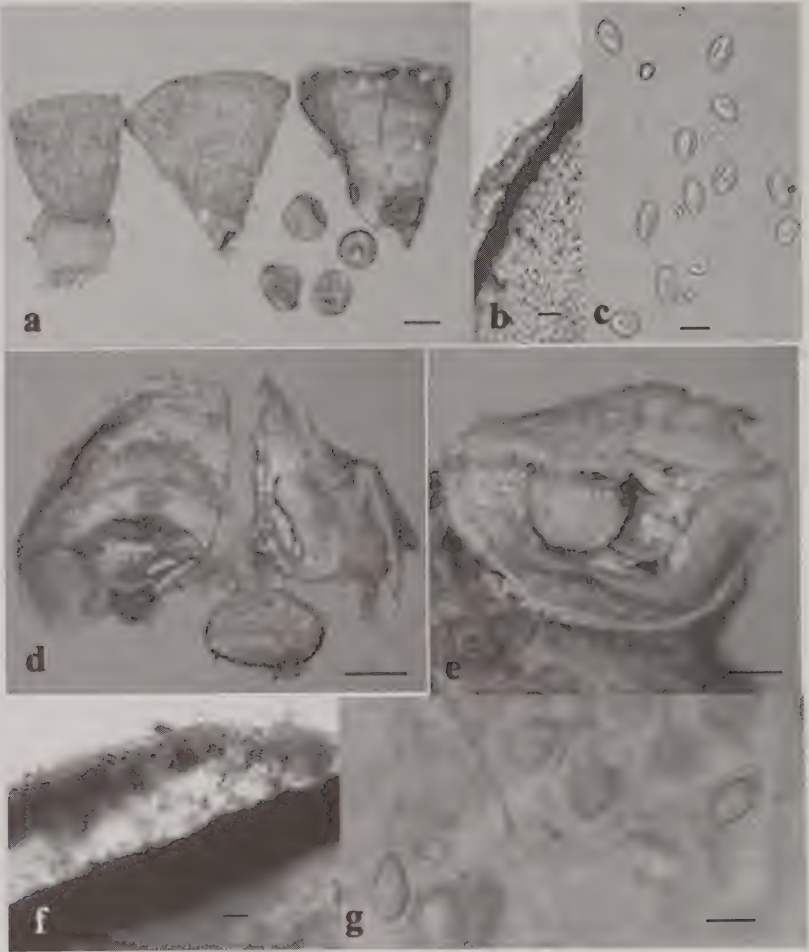


FIGURE 2. Comparison between a-c [*Cyathus pygmaeus* (BPI 703514 Holotype)] and proposed synonym d-g [*Cyathus gansuensis* (SWFC 20880 Holotype)]. **a**—Fruiting bodies, bar = 1.4 mm; **b**—Section of peridiole, one cortex with tunica, bar = 20 μ m; **c**—Basidiospores, bar = 9 μ m; **d** & **e**—Fruiting bodies, bars = 1 mm; **f**—Section of peridiole, one cortex with tunica, bar = 10 μ m; **g**—Basidiospores, bar = 10 μ m.

Lloyd, showed a flared mouth on its single fruiting body. Presence of a flared mouth is therefore a variable character in this species. The tiny fruiting bodies, in combination with a dark internal surface of the peridium, however, are reliable characters for species diagnosis. Moreover, the habitat of *C. pygmaeus* in arid areas is also a good diagnostic feature (Brodie 1975).

When *C. gansuensis* was introduced by Yang et al. (2002), it was stated to differ from *C. pygmaeus* in having larger fruiting bodies (4-6 (-9) mm high, (3.5) 5-8 (-9.5) mm wide), larger peridioles (1.5-2 mm long, 0.8-1.5 mm wide) and being darker on the inner surface of peridium. Based on our observations, the fruiting bodies and peridioles of *C. gansuensis* are of similar size to those of *C. pygmaeus*, and inner peridial surfaces are also dark brown. Furthermore the morphology of the peridioles and spores are indistinguishable from those of *C. pygmaeus* (Table 2). *Cyathus gansuensis* was collected from an arid area on Xinglongshan Mountain, Gansu Province. We therefore consider *C. gansuensis* to be synonymous with *C. pygmaeus*.

Cyathus poeppigii Tul. & C. Tul., Ann. Sci. Nat., Bot. III, 1: 77, 1844. **Figure 3**
= *Cyathus megasporus* W. Ren & T.X. Zhou, Acta Mycol. Sin. 11: 25, 1992.

Fruiting bodies obconical or narrowly obconical, some with mouths incurved, constricting abruptly at the base and forming a slender stipe, 6-8 mm high, 4-5 mm wide; exterior surface of peridium dark brown to reddish-brown with hairs long, appearing shaggy or hirsute; ridges distinct; internal surface of peridium dark brown to dark grey, deeply plicate, some splitting along the fluted lip; lip fimbriate, dark brown. *Peridioles* circular to subcircular, dark brown, 1.5-2 mm

Table 3. The comparison of mainly morphological characters between *Cyathus poeppigii* and its synonym *Cyathus megasporus*

Characters	<i>C. poeppigii</i>	<i>C. megasporus</i>
Shape of fruiting bodies	Cup-shaped with slender stipe	Long obconic with slender stipe
Size of fruiting bodies	5-8 × 4-5 mm	5-11 × 3.5-6.5 mm
Color of exterior surface of peridium	Brown, dark brown	Dark brown
Hairs on peridium	Aggregated into long tufts, some shaggy	Shaggy
Plications on peridium	Distinct on exterior and inner surfaces of peridium	Distinct on exterior and inner surfaces of peridium
Lip of fruiting bodies	Smooth or fimbriate	Fimbriate
Size of peridioles	1.5-2 mm in diam.	1.5-2 mm in diam.
Structure of peridioles	Double cortexes	Double cortexes
Shape of basidiospores	Ellipsoid, ovoid	Ellipsoid
Size of basidiospores	(20-)30-45(-50) × (15-)18-30 μm Brodie: 30-42 × 20-28 μm	25-30 × 15-16 μm Ren & Zhou: (24-)31-55(-68) × (15-)18-36.5(-47) μm
Materials source	2 specimens identified by us	Holotype

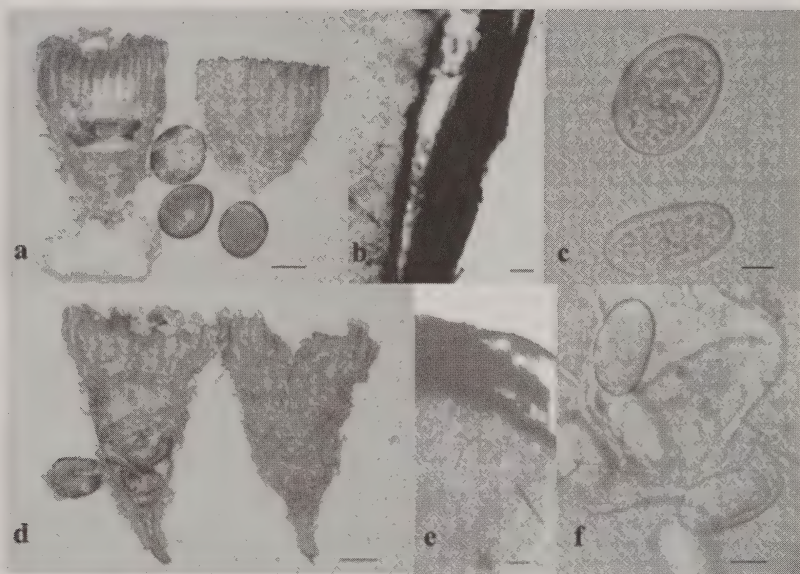


FIGURE 3. Comparison between a-c [*Cyathus poeppigii* (SWFC 21357)] and proposed synonym d-f [*Cyathus megasporus* (SWFC 20448 Holotype)].

a—Fruiting bodies, bar = 2 mm; b—Section of peridiole, double cortex, bar = 15 µm; c—Basidiospores, bar = 20 µm; d—Fruiting bodies, bar = 1.5 mm; e—Section of peridiole, double cortex without tunica, bar = 20 µm; f—Basidiospores, bar = 16 µm.

diam.; double cortex 50-75 µm thick, composed of interwoven reddish-brown hyphae, without a tunica. *Basidiospores* hyaline, smooth, broadly ellipsoid to ovoid, rounded at both ends, thick or thin walled, (20-)30-45(-50) x (15-)18-30 µm.

Known distribution: Common in tropical areas of Africa, China, Hawaiian Islands, South America and the West Indies (type location: Cuba).

Material examined: Two specimens of *C. poeppigii*: CHINA, Hunan province, Jiuyishan Mountain, 4 Jan. 2001, L.Z. Zhao, SWFC 21400; CHINA, Yunnan Province, Longchuan, 5 July 2000, L.Z. Zhao, SWFC 21357. One specimen of *C. megasporus*: CHINA, Yunnan Province, Kunming, 23 Nov. 1987, X. Xing, SWFC 20448 (Holotype).

Notes: *Cyathus poeppigii* is characterized by deep plications on the inner peridium, dark brown or reddish brown color, double cortices in the peridioles and very large basidiospores. The principal variation observed among the collections examined is in basidiospore size. Brodie (1975) stated: "spores of *C. poeppigii* are always large and variable", and "when other characteristics are remarkably constant, the author does not feel that spore size ought to be unduly emphasized as a diagnostic feature of *C. poeppigii*".

Cyathus megasporus was described as a new species by Ren & Zhou (1992) based primarily on its large spore size, reported as (24-) 31-55 (-68) x (15-) 18-36.5 (-47) μm . This is larger than those of *C. poeppigii* whose spores are 30-42 μm x 20-28 μm (Brodie 1975). Re-examination of the holotype of *C. megasporus* revealed that the basidiospores measured 25-30 x 15-16 μm , and other morphological characters were indistinguishable from those of *C. poeppigii* (Table 3). We therefore consider *C. megasporus* to be a synonym of *C. poeppigii*.

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A new species of *Bactrodesmium* from Lithuania

SVETLANA MARKOVSKAJA

svetlana.m@botanika.lt

*Institute of Botany, Laboratory of Mycology
Žaliųjų ežerų 49, LT-08406, Vilnius, Lithuania*

Abstract--*Bactrodesmium pusillum*, a new species of dematiaceous hyphomycete, collected on unidentified decaying wood and on wood of *Quercus robur* and *Picea abies* in forest litter in Lithuania, is described and illustrated. The fungus differs from known species of the genus by the size of the conidiophores and by the shape, size, septation and colour of the conidia.

Keywords--anamorphic fungi, taxonomy

Introduction

The genus *Bactrodesmium* Cooke was established for species with small, sparsely scattered or clustered and effused, dark brown or black sporodochia. The generic name was proposed by Cooke (1883) for two species of the genus *Sporidesmium*: *S. abruptum* Berk. & Broome and *S. spilomeum* Berk. & Broome with clavate multiseptate conidia, but without correct nomenclatural changes. The valid nomenclatural changes were made later by Mason & Hughes. For the first time Mason & Hughes proposed new combination for *Bactrodesmium abruptum* (Berk. & Broome) E. W. Mason & S. Hughes in Rimington (1953), but it was invalidly published. Hughes (1958) validated the combination and proposed *B. abruptum* as lectotype. The new combination of *Bactrodesmium spilomeum* (Berk. & Broome) E. W. Mason & S. Hughes was validly published in Hughes (1953). The genus has been expanded and nomenclatural changes have been made by Cooke & Harkness (1884), Sutton (1967, 1977), Ellis (1959, 1971, 1976), Holubová-Jechová (1972), Borowska (1975), Matsushima (1981, 1993, 1995), Palm & Stewart (1982), Hughes (1983), Hughes & White (1983a-e), Kirk (1983, 1986), Rao (1983), Castañeda & Arnold (1985), Rao & de Hoog (1986), Udaiyan (1991), Révay (1993), Mercado et al. (1995), Zucconi & Lunghini (1997) and Cooper (2005).

At present time about 40 species are recognized in the genus, but the type of conidial secession in the genus for many species is still dubious. Prior to 1997

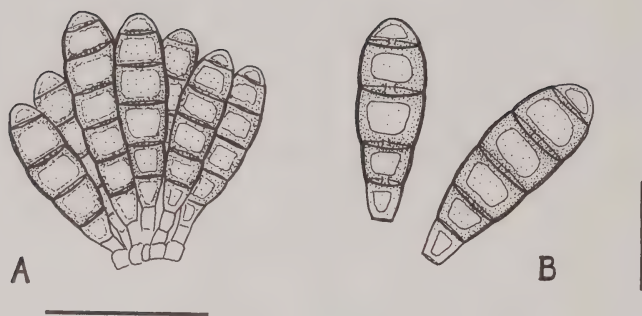


Fig. 1. *Bactrodesmium pusillum* (from holotype). A. Conidiophores with conidia. B. Conidia. Bars: A = 20 μ m; B = 10 μ m.

the nature of conidial secession, schizolytic or rhexolytic, in *Bactrodesmium* was under discussion. This character sometimes is very difficult to determine; some authors (Palm & Stewart 1982, Zucconi & Lunghini 1997, Cooper 2005) noted that a breach in the wall of conidiogenous cell in separate species may remain as a frill at the base of schizolytically seceding conidia. Zucconi & Lunghini (1997) critically examined type material preserved (RO, No 1163) as *Sporidesmium abruptum* and suggested that the genus should be characterized by schizolytic conidial secession. Thus species described as having rhexolytic conidial secession or those who the nature of secession is dubious need further taxonomical study.

Materials and methods

The material was collected in spruce (*Picea abies*)-dominated Jagelonys forest (Trakai district) of Lithuania. Samples of decaying wood of unidentified tree species and of *Picea abies* and *Quercus robur*, containing fungi were dried and preserved. Description and illustration of the new species *Bactrodesmium pusillum* were made from fresh preparations in distilled water and in 25% lactic acid. Representative specimens of the fungus are deposited in the herbarium of the Institute of Botany, Vilnius, Lithuania (BILAS); some duplicates are deposited in the Komarov Botanical Institute, St. Petersburg, Russia (LE).

Taxonomic Description

Bactrodesmium pusillum Markovskaja sp. nov.

MYCOBANK MB 510340

Fig. 1-7

Sporodochia punctiformia, *dispersa*, *effusae*, *pulvinata*, *nitida*, *fusco brunnea*. Mycelium plerumque immersum, ex hyphis ramosis, septatis, subhyalinis vel dilute brunneis, 1-2.5



Fig. 2-7. *Bactrodesmium pusillum* (from holotype). 2-3. Sporodochia.

4-6. Conidia. 7. Conidiophore with conidia.

Scale bars: 2-3 = 20 μm ; 4-5 = 10 μm ; 6-7 = 20 μm .

μm latis compositum. Conidiophora solitaria, semi-macronematica, simplicia, laevia, ex 1-2 cellulis composites, ramosa, hyalina vel subhyalina, 7.5-10 μm longis, 2-3 μm latis. Cellulae conidiogenae holoblasticae, monoblasticae, integrae, terminales, determinatae, cylindricae vel clavatae. Conidia acrogena, solitaria, laevia, anguste ellipsoidea vel clavata, (4-) 5 (-6) septatis, ad septa leviter constricta, (18-) 20-23 (-25) μm longis and 6.5-7.5 μm latis, pallide brunnea, cellula apicale subhyalina et rotundata, cellula basali subhyalina vel hyalina, tenuata et truncata, 2-2.5 μm latis. Conidiorum secessio schizolytica. Teleomorphosis ignota.

Holotype--LITHUANIA. TRAKAI DISTR., Jagelonys forest (54°41'23"N, 23°34'54"E), on decaying unidentified wood, collected 10 September 2003, S. Markovskaja, (HOLOTYPE-BILAS 34904).

Etymology: from the Latin, *pusillus* -- referring to small size of sporodochia and conidia.

Sporodochia on wood scattered or clustered, effuse, pulvinate, dark brown. Mycelium immersed and superficial, composed of branched, septate, smooth, subhyaline or pale brown hyphae, 1-2.5 μm diam. Conidiophores simple, semi-

macronematous composed of 1-2 cells, thin-walled, hyaline to pale brown, 7.5-10 μm long, 2-3 μm broad. Conidiogenous cells holoblastic, monoblastic, integrated, determinate, terminal, hyaline, cylindrical to clavate. Conidia acrogenous, solitary, smooth, elongate ellipsoid to clavate, (4-) 5 (-6), slightly constricted at the septa, (18-) 20-23 (-25) μm long and 6.5-7.5 μm broad, pale brown, apical cell subhyaline and rounded, basal cell subhyaline to hyaline, tapering and truncate, 2-2.5 μm wide. Conidial secession schizolytic.

Teleomorph unknown.

OTHER SPECIMENS EXAMINED—on decaying wood of (? *Quercus*), LITHUANIA, **Trakai district**, Jagelonys forest, (54°41'23"N, 23°34'54"E), 10 September 2003, S. Markovskaja, BILAS 34907 (duplicate in LE 230711); on decaying wood of *Quercus robur*, LITHUANIA, **Trakai district**, Jagelonys forest, (54°41'23"N, 23°34'54"E), 7 September 2004, S. Markovskaja, BILAS 34905; on decaying wood of *Picea abies*, LITHUANIA, **Trakai district**, Jagelonys forest, (54°41'23"N, 23°34'54"E), 7 September 2004, S. Markovskaja, BILAS 34906.

Discussion

Bactrodesmium pusillum morphologically is similar to *B. spilomeum*, *B. pallidum* M.B. Ellis, *B. biformatum* (Höhn.) S. Hughes, *B. submoniliforme* Hol.-Jech., *B. traversianum* (Peyronel) M.B. Ellis and *B. indicum* P. Rag. Rao, but the combination of its diagnostic characters does not agree with any of the published descriptions of these species (Table 1). The new species is readily distinguished from all other species by the size of its conidiophores and by the shape, size, septation and colour of its conidia. The new species is closest to *B. spilomeum*, *B. pallidum* and *B. biformatum* in shape of conidia, constriction at the septa and lacking thick bands, and differs mainly by smaller, almost sessile conidia with a conspicuous porus in the middle of each septum (Ellis 1959, 1971, Holubová-Jechová 1972, Hughes 1983, Révay 1993, Ellis & Ellis 1997). Holubová-Jechová (1972) noted that *B. pallidum* probably is a synonym of *B. spilomeum*, but other authors (Ellis & Ellis 1997, Tsui et al. 2003) and Index Fungorum (<http://www.indexfungorum.org/Names?Names.asp> 2004) recognize *B. pallidum* as a separate species. The newly described species is very close to *B. pallidum* in having pale brown pigmentation of conidia. According to Hughes (1983) *B. submoniliforme* is a synonym of *B. biformatum*, but in *B. biformatum* conidiophores and conidia are only very slightly constricted at the septa. *Bactrodesmium pusillum* resembles *B. traversianum* and *B. indicum* in shape and septation of conidia, but conidia of the latter two species were described as not constricted at the septa and are larger.

Conidial secession in *B. pusillum* was determined as schizolytic, although sometimes conidia bear a basal frill, the remnants of conidiogenous cells, as have been noted in *B. moenitum* (J.L. Crane & Shearer) M.E. Palm & E.L.

Table 1. Comparison of morphological characters between *B. pusillum* and similar species

Species	Conidiophores morphology and size (μm)	Conidial morphology	Septation and size of conidia (μm)	Colour of conidia
<i>Bactrodesmium pusillum</i>	Simple, 0-1 septate, $7.5-10 \times 2-3$	Elongate ellipsoidal to clavate	(4-) 5 (-6) septate, (18-) 20-23 (-25) $\times$ 6.5-7.5	Pale brown, apical and basal cells subhyaline
<i>B. biformatum</i> (Hughes 1983, Révay 1993)	Branched, septate, $10-25(-38) \times 2.5-6.5$	Elongate ellipsoidal to fusiform	(5-) 7-8 (-10) septate, (20-) 25-30 (-42) $\times$ 6-7(-10)	Pale brown to brown, apical and basal cells subhyaline
<i>B. indicum</i> (Rao 1983)	Simple, 0-3 septate, $6-15 \times 3-5$	Clavate to cylindrical	4-5 septate, $35-52 \times 7-11$	Yellowish to golden brown, basal cell subhyaline
<i>B. pallidum</i> (Ellis 1971, Ellis & Ellis 1997, Tsui et al. 2003)	Branched, septate, $20-65 \times 2-3$	Elongate ellipsoidal to cylindrical	5-6 septate, $35-55 \times 9-12$ (-18)	Pale brown to brown
<i>B. spilomeum</i> (Ellis 1959, 1971, Holubová-Jechová 1972)	Irregularly branched, septate, $25-34 (-75) \times 2-3$	Elongate ellipsoidal to clavate	(2-) 3-5(-6) septate, $22-40 (-45) \times (6-) 10-12 (-14)$	Pale brown to mid brown
<i>B. submoniliforme</i> (Hughes 1983, Holubová-Jechová 1972)	Branched, septate, constricted at the septa, $6.5-25 (-38) \times 2.5-6.5$	Elongate ellipsoidal to fusiform	(5-) 8-10 septate, conspicuously constricted at the septa	Pale brown to brown
<i>B. traversianum</i> (Ellis 1959, 1971)	Branched, 1-4 septate, $20-40 \times 2-3$	Ellipsoidal to clavate	3-6 septate, $20-37 \times 8-12$	Brown to dark brown, basal cell subhyaline

Stewart, *B. cubense* (R.F. Castañeda & G.R.W. Arnold) Zucconi & Lunghini and *B. nothofagi* J.A. Cooper (Palm & Stewart 1982, Zucconi & Lunghini 1997, Cooper 2005).

Apart from the newly described *Bactrodesmium pusillum*, five additional species of the genus *Bactrodesmium* were collected on decaying wood of different trees in various forests in Lithuania: *B. betulicola* M.B. Ellis, *B. biformatum*, *B. obovatum* (Oudem.) M.B. Ellis, *B. pallidum* and *B. spilomeum*. *Bactrodesmium spilomeum* is common in Lithuania, meanwhile *B. biformatum* is rare, collected only twice on decaying wood of *Corylus avellana*. *Bactrodesmium obovatum*, *B. pallidum* and *B. betulicola* are frequent wood saprobes, the latter was collected exceptionally on *Betula*.

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Three new lichens from Turkey

KENAN YAZICI

kcagri_1997@yahoo.com

*Biology Department, Giresun Science and Art Faculty
Karadeniz Technical University, Giresun, Turkey*

Abstract—Three species of lichenized fungi – *Cladonia rei*, *Lecidea lithophila* and *Porpidia soledizodes* – are reported as new to the lichen flora of Turkey. For each a short description is presented.

Keywords—Ascomycetes, biodiversity, Trabzon

Although the lichen flora of Turkey is largely unknown and many regions have yet to be investigated, in recent years there has been a substantial increase in the attention paid to this country (Aslan 2000, Aslan et al. 2002a,b, John 1995, John & Breuss 2004, Yazıcı 1999a,b, Yazıcı & Aslan 2002, 2003, 2006, Yazıcı et al. 2004).

The present report is based on samples collected on three different stations in Trabzon between 15 August 2004 and 15 May 2005. A stereo microscope, a compound microscope and the standard spot tests were used in the identification of the samples, together with the following references: Clauzade & Roux (1985), Fryday (2005), Poelt (1974), Purvis et al. (1992) and Wirth (1995). Vouchers have been stored in the herbarium of Biology Department, Giresun Science and Art Faculty, Karadeniz Technical University.

Results

Cladonia rei Schaer.

Podetia to 3.5 cm high, to 3.3 mm across, tapering upwards to a point, mostly green-gray sometimes green-brown, usually edge of aged cups longitudinally split, mostly simple; granular soredia discontinuous, from basal to podetial disc and also in cups, not on basal portion, sometimes squamulose patches present from basal up to cups, but mostly only in the base; basal portion of podetia not all blackening; cups slightly constricted at the base, margins not

proliferating. Apothecia brown and rare. Podetia Pd– or red, medulla Pd– or Pd + yellow, orange, or red, UV+ dull bluish (HTLC: homosekikaic, sekikaic and fumarprotocetraric acids).

Found growing over sandy and often somewhat base rich soil, also over mossy rocks, in open inland sites at lower altitudes, especially disturbed sites; also known from maritime localities.

Known from Asia (Iran), Australia and New Zealand, Europe (Belgium, England, Luxembourg, Netherlands, Denmark, Germany, Slovakia, Slovenia), and the USA (Rhode Island, California, Pennsylvania).

Trabzon: Akçaabat; Bozdoğan köyü, on mosses, at 250m, 40° 59' 55" N, 39° 28' 45" E, 15 May 2005, Yazici 1278.

Remarks—*Cladonia rei* resembles *Cladonia subulata* and *Cladonia glauca*. *Cladonia rei* has less branched podetia and often have deformed cups that proliferate only infrequently; those in *C. subulata* are differently coloured (red–brown), branch more frequently, and have podetia with red–brown apothecia that are often irregularly branched, appear antler–like, and often proliferate. Both *C. rei* and *C. subulata* possess fumarprotocetraric acid, but only *C. rei* has homosekikaic. Of three similar species, only *C. glauca* possesses squamatic acid. *C. rei* is dirty or drab green–brown, but *C. subulata* is dull to bright grey–green (Purvis et al. 1992).

Lecidea lithophila (Ach.) Ach.

Thallus thin, slightly warted, ± continuous to irregularly cracked–areolate, to slightly warted, pale grey to slightly blue–grey, often partly rust–red, medulla I–; prothallus generally indistinct. Apothecia (0.15–)0.55–2.2(–2.4) mm diam., staying in groups of 1 to 3, dark brown to black, disc black–brown, brown when wet, ± margin the same colour, immersed in the early stages; disc ± flat, convex in later stages, not constricted below; true exciple persistent, raised, ± with greenish tinge, internally pale brown to ± colourless, K–; epihymenium olive–brown, K–; hymenium (40–)50–75 µm tall; hypothecium colourless. Paraphyses anastomosing and sparsely branched with brownish apices. Asci elongate–clavate, Lecidea–type. Ascospores 10–15 x 5–6(–7) µm, ellipsoid. Thallus and medulla Pd–, K–, KC–, C– (HTLC: 4–O–demethylplanaiic and ± planaiic acids).

Found on exposed siliceous rocks, stones and pebbles, especially those rich in iron.

Known throughout Europe, North America, and southeast China.

Trabzon: Düzköy; Beypınar high plateau, on siliceous rock, at 700 m, 40° 48' N, 39° 20' E, 15 August 2004, Yazici 1281.

Remarks—*L. lithophila* is similar to *L. plana*. But *L. plana* has a predominantly immersed thallus that is pale-grey, not rust-coloured as in *L. lithophila*. *L. plana* has smaller ascospores and apothecia with a shorter hymenium and a greenish, not brownish, epithecium. In fresh specimens of *L. plana*, the disc remains black in comparison to the brown colors of *L. lithophila*. Finally, the apices of the paraphyses are dark-green in *L. plana*, not brownish (Purvis et al. 1992).

Porpidia soredizodes (Lamy ex Nyl.) J.R. Laundon

Thallus generally small, sometimes spreading (to 7–8 cm diam.), 0.5(–0.6) mm thick, dirty creamish grey, subcontinuous rimose, subareolate to somewhat scurfy and indistinct; prothallus black, arachnoid, often visible between areoles; medulla I–. Soralia to 0.3–0.6(–0.7) mm diam., scattered, round or some irregular, usually tuberculate, punctiform; soredia white to yellow-greenish white, farinose to granular. Apothecia rare, scattered, to 0.9 mm diam., mostly solitary, sometimes contiguous in groups of 2 to 3, mostly $\pm$ immersed, round to irregular; true exciple thick (0.15–0.20 mm), black; disc black or brownish black, not pruinose, flat, matt; epithecium brown. Ascospores 13–18(–21) $\times$ 6–8(–9) μ m. Hymenium 90–150(–160) μ m tall. Thallus K + yellow, Pd + orange, soralia Pd + orange, K + yellow (HTLC: stictic acid).

Grows on siliceous rocks, stonework pebbles and slate in lowlands.

Known throughout Europe (British Isles, Italy, Austria) and Australia.

Trabzon: Düzköy; Beypınar high plateau, on siliceous rock, at 700 m, 40° 48' N, 39° 20' E, 15 August 2004, Yazici 1275.

Remarks—A generally smaller, thinner and darker thallus helps differentiate *P. soredizodes* from *P. tubulosa*. *P. soredizodes* has a taller hymenium, smaller soralia and apothecia, but larger ascospores. *P. soredizodes* has a brown epithecium while the epithecium in *P. tubulosa* is brown-olive. On the other hand, *P. soredizodes* has brownish-black, flat, shiny and smooth discs while those in *P. tubulosa* are black, subconvex, matt and sometimes pruinose (Purvis et al. 1992).

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***Phytophthora inundata* isolated from diseased alfalfa roots in Southern California**

H.H. HO¹, C.X. HONG² & D.C. ERWIN³

¹ hoh@newpaltz.edu

Department of Biology, State University of New York
New Paltz, New York 12561, USA

² chhong2@vt.edu

Hampton Roads Agricultural Research and Extension Center, Virginia Tech
Virginia Beach, VA 23455, USA

³ marieg@ucr.edu

Department of Plant Pathology, University of California
Riverside, CA 92521, USA

Abstract—*Phytophthora inundata* was isolated from diseased alfalfa roots in Imperial County (Imperial Valley) of California. It is characterized by non-papillate, non-deciduous, internally proliferating ovoid to obpyriform sporangia, relatively large oogonia (av. 43 µm) with thick-walled, apertotic oospores, predominantly or entirely amphigynous antheridia, spherical hyphal swellings with radiating hyphae and cardinal temperatures of 5, 27–28, and 36°C. The similarity in morphology and cultural characteristics between the alfalfa isolate and *P. inundata* was confirmed by single-strand conformation polymorphism (SSCP) and DNA sequence analyses. This is the second world record of *P. inundata* found outside UK and Europe and although it is the first report of its association with diseased alfalfa roots, it was weakly pathogenic to alfalfa seedlings. The significance of this new discovery is discussed.

Keywords—Oomycetes, *Medicago sativa*, Pythiaceae fungi, Stramenopile, root rot

Introduction

In September 1997 the third author, as a favor for an alfalfa plant breeder, made isolations from rotten roots of alfalfa (*Medicago sativa* L.) plants suspected to be affected by *Rhizoctonia* root rot canker (Smith 1943). They were collected from a 2 year-old stand of alfalfa that was flood irrigated and located in the Imperial Valley of Southern California (Imperial County), a region in which high temperatures prevail in the summer. However, when portions of the rotted root tissue were plated on the *Phytophthora* selective medium one interesting *Phytophthora* isolate was obtained which appeared to differ slightly from *P.*

medicaginis E.M. Hansen & D.P. Maxwell and the high temperature variant of *P. megasperma* Drechsler (Ribeiro et al. 1978) which caused root rot of alfalfa in California. The classification of the new isolate was difficult. At first it produced only spherical hyphal swellings in water but eventually, techniques were developed to induce the production of sporangia and sex organs successfully. Still this isolate could not be assigned to any known *Phytophthora* species listed by Erwin & Ribeiro (1996) based on morphology.

As early as 1970, an unidentified *Phytophthora* species had been isolated from rotted roots of horse chestnut (*Aesculus hippocastanum* L.) and willow (*Salix matsudana* Koidzumi) by Brasier et al. (1993). They considered these isolates to be a new taxon which they designated as 'O-group'. Sanchez-Hernandez et al. (2001) in Spain reported that *Phytophthora* 'B group' isolates from olive (*Olea europaea* L.) closely resembled those in 'O group' and were 'severely aggressive' when roots of olive trees were inoculated. In 2003 Brasier et al. formally described the 'O group' isolates as a new species: *Phytophthora inundata* Brasier et al. It appeared that the new isolate from alfalfa closely matched the description of *P. inundata*. Subsequently, we were able to secure four isolates of *P. inundata* and compare them with the isolate of *Phytophthora* from alfalfa along with two more similar *Phytophthora* species. The classification of the new isolate was based both on morphological and molecular studies.

Materials and Methods

Isolates and cultures

Diseased alfalfa roots were washed in running tap water, surface disinfected with 10% sodium hypochlorite, washed, and blotted dry. Small pieces of rotted root tissue were plated on Difco cornmeal agar containing (ppm) pimaricin (10), ampicillin (130), rifampicin (20), pentachloronitrobenzene (100) and hymexazole (40) (PARPH). The alfalfa isolate, P3.10.4 (= Hong's 28F2), was maintained on 10% clarified V-8 agar slants or screw-capped tubes of sterile distilled water. Morphological studies of P3.10.4 were made on 10% V-8 agar medium. Campbell's V-8 juice was used directly or was clarified by filtering through 4 layers of cheese cloth and one layer of coarse filter paper. Seven additional isolates representing three similar *Phytophthora* species also were included for comparison (Table 1). Stock cultures of these isolates were maintained at Hong's laboratory using a similar method.

Production of sporangia

Three small mycelial agar discs (ca 5 mm square) were cut from the advancing margin (hyphal tips included) of a 3-day old colony, grown at 25°C, were transferred to a sterile disposable 60 mm diam Petri dish containing either

Table 1. Isolates examined in this study

Species	Track #	Host/substrate	Location	Year	Supplier (#) ^s
<i>P. inundata</i>	30J3	<i>Olea</i> roots	Spain	1996	CB (P894)
	30J4	<i>Salix matsudana</i> roots	UK	1972	CB (P246B)
	32F5	<i>Aesculus hippocastanum</i> roots	UK	1970	MC (P8478)
	28F2	<i>Medicago sativa</i> roots	USA		DE (P3.10.4)
<i>P. humicola</i>	32F8	<i>Citrus</i> soil	Taiwan	1976	MC (P3826)
<i>P. medicaginis</i>	23A4	<i>M. sativa</i> roots	USA		MG (P37)
	28F1	<i>M. sativa</i> roots	USA		DE (EP1057)
	29B1	<i>M. sativa</i> roots	USA	1982	EH (29)

^s CB=Clive Brasier; DE=Donald Erwin; EH=Everett Hansen; MC=Michael Coffey; MG=Mannon Gallegly. Listed in the parenthesis are alternative identifiers used by isolate suppliers.

freshly collected stream/pond water or stream/pond water sterilized by filtration through a Millipore membrane (0.45µm pore size). The agar discs were barely covered by water. A 20×40 mm cover slip sterilized by dipping in 90% ethanol followed by flaming was placed on the bottom of the Petri dish to collect encysted zoospores. The dishes were incubated under continuous fluorescent light at 24–25°C and checked for sporangial production and encysted zoospores after 24–48 hours.

Production of sex organs

Isolate P3.10.4 was grown either on 20% regular or clarified V-8 agar (supplemented with 30 mg/l sitosterol) in 60 mm diam Petri dishes, sealed with two layers of parafilm and incubated at 25°C in darkness for at least 2–3 months. P3.10.4 was also paired with M.D. Coffey's (University of California, Riverside, CA) isolates of A1 (P2100, P2399) and A2 (P2040) mating types of *P. cinnamomi* Rands from avocado (*Persea americana* Mill.) in California and with a sterile isolate of *P. cryptogea* Pethyb. & Laff. (Gi9961) from *Gerbera jamesonii* Bolus in Hainan, China (Zeng et al. 2003). Cultures were incubated at 25°C in darkness for 3 weeks. The locations of the sex organs formed by P3.10.4 on the bottom of the Petri dish were marked with a fine felt pen after they were observed by bright field microscopy.

Morphological studies

Small agar discs bearing the reproductive structures of P3.10.4 were either mounted directly on a glass slide or first boiled briefly in distilled water to remove the agar. After the mycelia and oorgonia were carefully minced and

spread out evenly in a drop of 0.05 % cotton blue/lactophenol with a pair of 1 ml syringe needles, a 20x50 mm cover slip was placed on top of a glass slide, and the reproductive structures were observed and photographed with a Nikon Eclipse E800 research light microscope by interference contrast microscopy. Encysted zoospores, which had formed on a submerged 20x40 cover slip, were observed after staining with a small drop of 0.05% aniline blue/lactophenol. Twenty five measurements were made for each reproductive structure at a magnification of 400x. Only normal, fully mature sporangia and sex organs were recorded.

Temperature response

Comparative studies of P3.10.4 were done with a type isolate of *P. inundata* (Brasier's isolate P894 = Hong's 30J3) on carrot agar (Erwin & Ribeiro 1996) in 9 cm diam Petri dishes on which the initial inoculum was transferred from the margin of a growing colony to the center of the carrot agar plate. Three replicates of each isolate were tested at each temperature (5, 10, 15, 20, 25, 30, 36, or 37°C). The growth chambers were calibrated at the respective temperatures prior to the assay. Two colony diameters were measured through the center of each plate after 4 days of incubation in darkness and the averages were recorded.

PCR-SSCP analysis

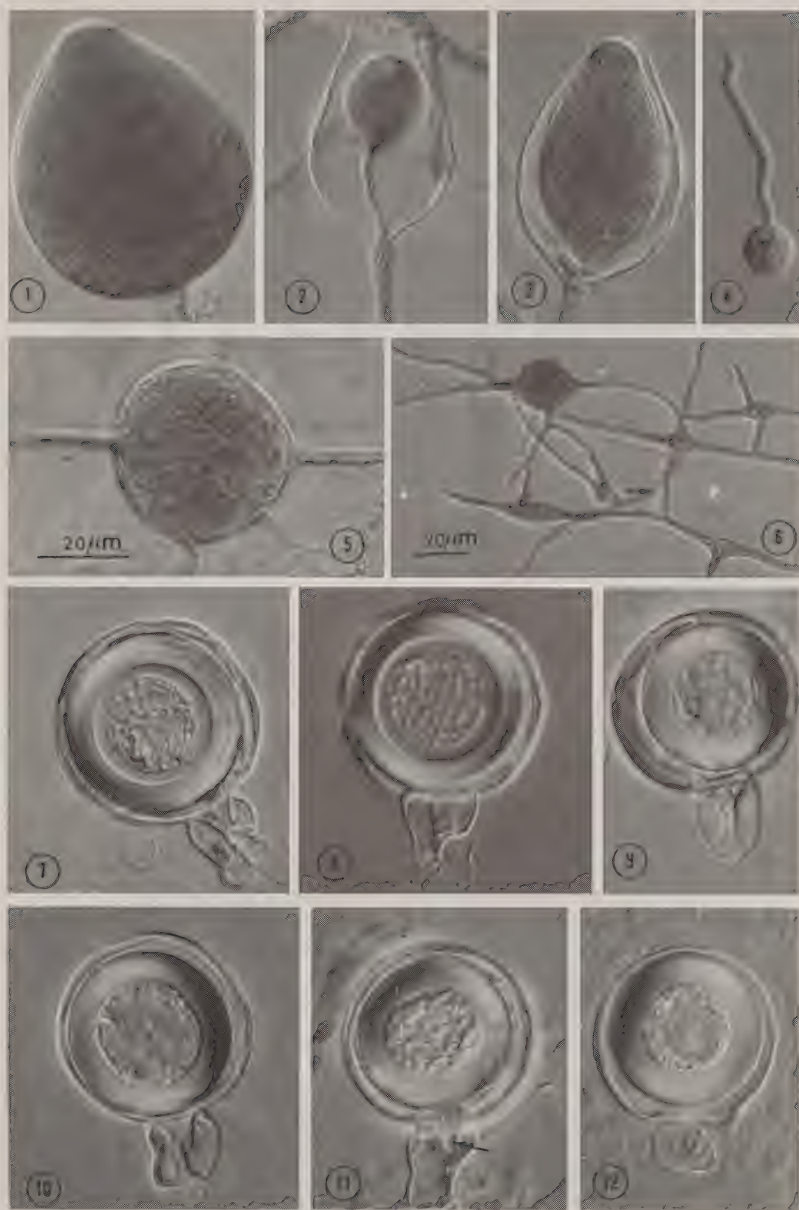
The alfalfa isolate P3.10.4 was compared with seven other *Phytophthora* isolates (Table 1). Culture DNA of individual isolates was prepared using a boiling method (Kong et al. 2003a). PCR was performed using forward primer ITS6 and reverse primer ITS7 to amplify ribosomal DNA, and the resultant PCR products were electrophoresed in a polyacrylamide gel (Kong et al. 2003b, 2004).

DNA sequence analysis

The PCR product of the alfalfa isolate P3.10.4 was purified using the Promega Wizard PCR Prep DNA purification system (Cat # A7170). The fragment was eluted in 50 µl ultrapure dH₂O and sequenced by MWG Biotech in High Point, NC. Sequencing was performed in both directions using forward primer ITS6 and reverse primer ITS7. The resultant sequence was compared with those deposited in Genbank at www.ncbi.nlm.nih.gov/blast/Blast.cgi.

(*Phytophthora inundata*). Fig.1. Non-papillate sporangium, Figs 2,3. Internal proliferation of sporangia, Fig. 4. Encysted zoospore germinating directly by a germ tube, Fig. 5. Hyphal swelling, Fig. 6. Hyphal swelling and mycelium, Figs. 7-10. Smooth walled spherical oogonia containing thick-walled oospores and amphigynous antheridia, Fig. 11. Oogonium with the stalk (arrow) eccentric, Fig. 12. Oogonium with a paragynous antheridium.

All figures, except Fig. 6 were enlarged at the same magnification, shown in Fig. 5.



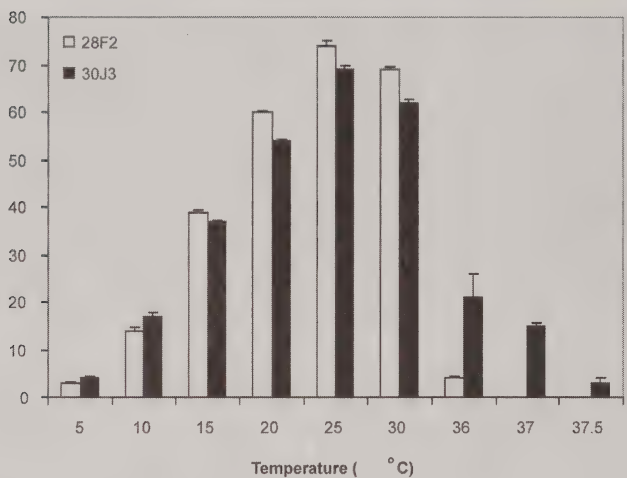


Figure 13. Colony diameters of the alfalfa isolate P3.10.4 (=28F2) and *Phytophthora inundata* (P894 = 30J3) after 4 days incubation on carrot agar at various temperatures. Each column is a mean of three replicates (six measurements), topped by a standard error bar.

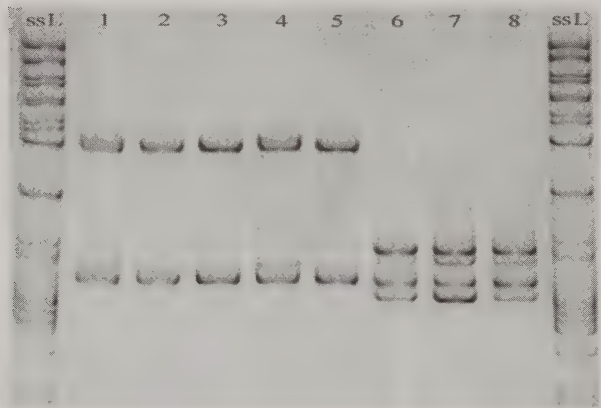


Figure 14. Polyacrylamide gel electrophoresis of amplified ribosomal DNA using forward primer ITS 6 and reverse primer ITS 7 to show the similarity of the alfalfa isolate P3.10.4 (=28F2, lane 4) to isolates of *P. inundata* (30J3, 30J4, 32F5 in lanes 1 to 3) and *P. humicola* (32F8, lane 5) and differences from *P. medicaginis* (23A4, 28F1, 29B1 in lanes 6 to 8) using forward primer ITS 6 and reverse primer ITS7. A single-stranded DNA ladder [6] was included in the left and right lanes.

Results

Morphology

The colony of P3.10.4 on V-8 agar was fluffy with no distinct growth pattern. The mycelium was hyaline, freely branched, smooth-walled, uniform, nonseparate or septate with age, and 5–6 μm wide. Sporangiphores were produced only in water, undifferentiated, unbranched, internally proliferating or rarely lax sympodially branched. Sporangia (Figs. 3–5) were terminal, non-deciduous, hyaline, ovoid or obpyriform measuring (37–) 66 (–86) μm in length and (29–) 49 (–61) μm in breadth. The length/ breadth ratio was (1.2–) 1.35 (–1.67). Encysted zoospores were spherical, 12–13 μm diam germinating by (1–4) germ tubes (Fig.4). Repeated emergence of zoospores was not observed. Hyphal swellings in water were angular, oval to mostly spherical (17–) 36 (–42) μm in diam with radiating hyphae (Figs. 1,2), either singly or catenulate. Sex organs (Figs. 7–12) were formed in aged cultures around the inoculum and in localized areas on the V-8 agar plates. The pairing with A1 and A2 isolates of *P. cinnamomi* was erratic and inconclusive. However, abundant sex organs were induced by pairing the P3.10.4 alfalfa isolate with a sterile isolate of *P. cryptogea* from *Gerbera* in Hainan, China. Oogonia were formed at the juncture where the two colonies met and on the P3.10.4 isolate side of the agar plate. The morphology of these sex organs was similar to those produced in aged cultures. The oogonia were globose, smooth-walled, hyaline to light brown, (38–) 43 (–48) μm in diam, each containing aplerotic, single, globose, smooth, hyaline to yellowish oospores (30–) 37 (–40) μm diam. The oospore wall was (5–) 7 (–9) μm thick and the antheridia were predominantly or entirely amphigynous, cylindrical to short (8–) 14 (–20) $\times$ (7–) 13 (–18) μm with the oogonial stalk sometimes distinctly eccentric entering the amphigynous antheridium at a point close to the oogonium (Fig. 11). Paragynous antheridia (Fig. 12) were rarely found. Chlamydospores were not observed.

Temperature response

On carrot agar, the alfalfa isolate (P3.10.4) closely resembled the type isolate of *P. inundata* (Hong's 30J3) by production of distinctly broadly lobed colonies and with similar growth/temperature relations (Fig. 13). The minimum temperature for growth was 5°C, optimum 27–28°C and the maximum 36°C for 28F2 and 37.5°C for 30J3.

PCR-SSCP and DNA sequence analyses

The alfalfa isolate P3.10.4 produced an SSCP pattern identical to that of *P. inundata* and *P. humicola* W.H. Ko & Ann but clearly distinct from that of *P. medicaginis* (Figure 14). The amplified DNA fragment is 226 bp in length. Its sequence is almost identical to that (AF266791) of the type isolate of *P. inundata* with only one base deletion. Surprisingly, this sequence did not produce good

alignment with those of *P. humicola* (none among the top 100 blast hits), indicating that P3.10.4 is different from *P. humicola*.

Discussion

Although *P. medicaginis* is the major cause of root rot of alfalfa and is found in most of the alfalfa producing regions of the world, five other species have been reported to be causal agents of root rot of alfalfa: *P. citricola* Sawada, *P. drechsleri* Tucker, *P. megasperma*, *P. nicotianae* Breda de Haan (Erwin & Ribeiro 1996) and the high temperature variant of *P. megasperma* (Ribeiro et al. 1978) that was reclassified by Ann & Ko (1994) as *P. insolita* Ann & W.H. Ko. The new isolate P3.10.4 from alfalfa from Imperial County of California can be easily distinguished from *P. citricola* and *P. nicotianae* which on agar medium produce respectively, semi-papillate and papillate sporangia. *Phytophthora drechsleri* produces variably shaped sporangia that are often elongated with a tapering base and smaller oogonia with amphigynous antheridia; *P. medicaginis* has a slower growth rate and smaller oogonia with a varying proportion of paragynous and amphigynous antheridia; *P. megasperma* produces larger oogonia and its maximal temperature for growth is much lower; *P. insolita* produces a distinct appressed chrysanthemum-like colony on V-8 agar with a maximum temperature of 39–40°C for growth. In contrast, the P3.10.4 alfalfa isolate was only weakly pathogenic to alfalfa seedlings by artificial inoculation.

Both P3.10.4 and *P. inundata* respectively, produce nonpapillate, internally proliferating sporangia of similar size (av $66 \times 49 \mu\text{m}$ vs $64.5 \times 47.7 \mu\text{m}$) and shape (length : breadth ratio 1.2–1.67 vs 1.2–1.5) and similar oogonia av 43 vs $49.1 \mu\text{m}$ diam containing thick walled (7.0 vs $5.4 \mu\text{m}$) aplerotic oospores (av 37 vs $35.7 \mu\text{m}$ diam) and predominantly or entirely amphigynous antheridia (length av 14 vs $16.5 \mu\text{m}$; width av 13 vs $15.9 \mu\text{m}$). The alfalfa isolate P3.10.4 and a typical isolate of *P. inundata* produced similar broadly lobed colonies on carrot agar medium and the cardinal temperatures and growth rates were similar in both although *P. inundata* had a slightly higher maximum temperature growth (37.5°C) than P3.10.4 (36°C). Brasier et al. (2003) determined the upper temperature limit for growth for *P. inundata* as 35°C (3 isolates), 36°C (2 isolates) and 37°C (3 isolates). Although not mentioned in the original paper by Brasier et al. (2003), spherical hyphal swellings produced by P3.10.4 were similar to those of our isolates of *P. inundata*. The alfalfa isolate was similar to two isolates of *P. inundata* in being unpredictably and chimerically self-fertile (Brasier et al. 2003). The results of PCR-SSCP and sequence analyses support the placement of this alfalfa isolate in *P. inundata*. Although *P. inundata* and *P. humicola* have a similar SSCP pattern, *P. humicola* can be distinguished morphologically from *P. inundata* by its smaller oogonia with long oogonial

stalks and predominantly paragynous antheridia as well as a much lower maximal temperature for growth.

Phytophthora inundata is a difficult species to classify. In general, with the exception of *P. insolita* which is self-fertile producing oospores without antheridia, all *Phytophthora* species are either heterothallic producing amphigynous antheridia or homothallic forming antheridia which are either paragynous, amphigynous or a combination of both (Erwin & Ribeiro 1996). However, Brasier et al. (2003) demonstrated that isolates of *P. inundata* could be heterothallic, weakly heterothallic or 'sporadically and unpredictably self fertile' producing amphigynous or predominantly amphigynous antheridia and they used the term 'part heterothallic' to describe the mating system of this species (Brasier et al. 2003). One isolate in 'Group B' which should be now renamed as *P. inundata* produced as much as 27% paragynous antheridia (Sanchez-Hernandez et al. 2001). Although '*P. sp.* Group 0' was considered a new taxon (Brasier et al. 1993) it took almost a decade before Brasier et al. (2003) described it as a new species: *P. inundata*. We have experienced similar problems in identifying the new isolate from alfalfa. Although it was isolated in 1997 we were puzzled about its classification. Based on morphology, it could not be assigned with certainty to any known *Phytophthora* species at that time (Erwin & Ribeiro 1996). The publication of *P. inundata* as a new species by Brasier et al. (2003) brought to light the similarities between the alfalfa isolate and *P. inundata*. Our present comparative studies using traditional morphological criteria and two different molecular biology techniques have proved that the new isolate of *Phytophthora* P310.4 from diseased alfalfa roots in Imperial Valley of California should indeed be assigned to *P. inundata*. P3.10.4 has been deposited in ATCC with the accession number MYA-3663.

To date, *P. inundata* has been isolated from roots of diseased trees and shrubs in UK and Europe and is considered to be "a parasite of woody hosts in riparian ecosystems, able to cause sporadic but severe disease outbreaks on susceptible hosts such as the ornamental *Aesculus* and *Salix*, or the commercially cultivated *Olea* or *Prunus*, after soil flooding or waterlogging" (Brasier et al. 2003). The isolation of *P. inundata* from diseased alfalfa roots in California not only has broadened its host range to include a herbaceous plant but also widened its geographic distribution to North America. The weak pathogenicity of the alfalfa isolate of *P. inundata* is puzzling because nearly all *Phytophthora* isolates are pathogens of the host from which they are isolated. There is a possibility that the alfalfa isolate might survive as a saprophyte in irrigation water and could be capable of attacking alfalfa roots only under predisposing environmental conditions, such as high soil moisture and at high temperatures. It would be of interest to determine its potential pathogenicity to woody hosts reported to be susceptible to *P. inundata* by Brasier et al. (2003).

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Blastocladia bonaerensis
(*Blastocladales*, *Chytridiomycetes*),
a new species from an Argentine channel

MÓNICA M. STECIOW & AGOSTINA V. MARANO

mstecioiw@museo.fcnym.unlp.edu.ar

Instituto de Botánica Spegazzini

53 N° 477, (1900) La Plata, Buenos Aires, Argentina

Abstract—*Blastocladia bonaerensis* sp. nov. was found in water containing litter (floating dead twigs, roots and leaves) in an artificial eutrophic channel, in Buenos Aires province (Argentina). The species is described, illustrated, and compared with other species of the genus; it produces mainly a small columnar and branched basal cell, which develops on lobes expanded distally, characteristic obpyriform zoosporangia with a long neck.

Key words—*Chytridiomycota*, *Fungi*, systematics

Introduction

The genus *Blastocladia* (*Blastocladales*, *Chytridiomycetes*) was established by Reinsch (1878) to accommodate a single species, *B. pringsheimii*; it was included among the doubtful genera of *Saprolegniaceae* by Fischer (1892) and remained there until Petersen (1909) erected the order *Blastocladales* with *Blastocladia* as the only genus. Since then many species have been added by various workers in the field (Sparrow 1960, Dasgupta & John 1989). Kirk et al. (2001) estimate the number of acceptable species with 13 species, but Index Fungorum presently lists 36 taxa (including 4 varieties + 1 excluded synonym, thus at most 31 species).

During a survey of zoosporic organisms occurring in polluted water and organic matter in Playa 66, an artificial channel near La Plata city, Partido de Berisso (Buenos Aires Province, Argentina), the authors found a species belonging to *Blastocladia* with distinctive features separating it from other species in the genus. It is here named *B. bonaerensis*.

Blastocladia globosa Kanouse and *B. pringsheimii* Reinsch were previously found in other polluted habitats at Partido de Chascomús (Stecioiw 1999) whereas *B. incrassata* Indoh, *B. sparrowii* Indoh, *B. tenuis* Kanouse and

B. ramosa Thaxt. were got at Partido de Ensenada, also located in Buenos Aires Province, Argentina (Steciow et al. 2001, Steciow & Eliades 2002).

Material and Methods

Samples of surface water containing organic litter (from twigs and leaves of the local vegetation) were collected from the site named "Playa 66", located in Partido de Berisso (Buenos Aires Province, Argentina) and were brought to the laboratory in sterile flasks. They were subsequently divided into 2 subsamples; one was used for chemical analysis while the other was left untreated so that live organisms could be observed and identified. The collection site is a water course that receives substantial discharges of both domestic sewage (from La Plata city and surrounding areas) and industrial effluents. At its margins profuse macrophyte vegetation of *Scirpus californicus* is growing.

At the sampling time, the following water quality data were recorded: pH = 7; turbidity = 58 UTN; conductivity = 822 $\mu\text{S cm}^{-1}$; BOD = 82 mg L^{-1} ; COD = 414 mg L^{-1} ; P = 1.363 mg P L^{-1} ; NO_3^- = 12.51 mg N L^{-1} ; NO_2^- = 0.136 mg N L^{-1} ; NH_4^+ = 1,865 (determined according to Mackereth et al. 1978). The high organic matter content classifies the channel as eutrophic.

Blastocladales are known to grow saprotrophically on submerged fruits and twigs. The method for collection described by Sparrow (1960), Dasgupta & John (1988), and Khulbe (2001) was used. Samples were placed in sterile flasks containing distilled water; rose fruits were used as baits and incubated at room temperature (15–20°C).

The dried type specimen is deposited in the Mycological Herbarium of Spegazzini Institute in La Plata (LPS). Because the original material was scarce on rose fruits, the fungus could not be isolated on agar media.

Measurements and observations were made using an Olympus BX 40 microscope (Olympus Optical CO., LTD, Tokyo, Japan) equipped with phase contrast optics.

Taxonomy

Blastocladia bonaerensis Steciow & Marano, sp. nov.

Figs 1-11

Mycobank MB 510331

Thalli cellula basilaris habitu et statura variabilis, saepe columnaris bene ramosa, (175-)225-320(-354) x 50-80 μm , pariete laevi vel rugosa tenui vel crassa, expansa ad apicem, simplici vel ramos cylindricos; rami usque ad 240-400 μm longi, ad apicem dichotomi vel in umbellis vel irregulariter dispositi. Pars basilaris valde ramose. Totus thallus 300-575 μm longus. Zoosporangia sessilia ad apicem ramorum vel super loborum dilatatorum

Figs. 1-4. *Blastocladia bonaerensis*. Fig. 1. Aspect of the pustules on rose fruits. Fig. 2. Thallus columnar trunk with dichotomous branching with the zoosporangia of different size and shape, surmounted the swollen branches on the tips of the thallus. Figs. 3-4. Aspect of dense pustules with details of obpyriform sessile zoosporangia with a long neck, borne on the branches or lobes with setae.

Scale bars, Fig. 1 = 100 μm ; Figs. 2-4 = 50 μm .





Figs. 5-11. *Blastocladiella bonaerensis*. Figs. 5-6. Details of pustules with obpyriform zoosporangia with a long neck borne on dichotomously, umbellately, or irregularly arranged branches; setae present or scarce. Figs. 7-11. Young thalli. Scale bar = 50 μ m.

superficie portata, saepe obpyriformia interdum fusiformia vel cylindrica vel naviculata vel obovata, (25-)32-75 µm x 17-37 µm; zoosporae ovoideae vel sphaericae 6-9 µm x 3-6 µm. Sporangia vacua non decidua. Sporangia quiescentia non observata.

Etymology: The name refers to the province (Buenos Aires) where this new species was found.

Basal cell variable in shape and size, generally columnar, sometimes clavate, often densely branched, (175-)225-320(-354) x 50-80 µm, **wall** smooth or rough, expanded distally and simple or giving rise to cylindrical, apically, dichotomously, umbellately, or irregularly arranged branches or broad lobes up to 240-400 x 80-160 µm; **setae** present or scarce, 2-6 µm wide; **holdfasts** richly branched, the **whole thallus** 300-575 µm long. **Zoosporangia** sessile, borne along the tips of the branches or over the surface of the swollen lobes, predominantly obpyriform with a prominent and characteristic apical beak, sometimes fusiform, cylindrical, naviculate and obovate, (25-)32-75 x 17-37 µm; **zoospores** ovoid and 6-9 x 5-6 µm, or spherical and 12-15 µm diam, emerging individually or in a columnar or pyriform group surrounded by an evanescent vesicle wall bearing an apical, persistent plug (the remains of the discharge papilla), empty sporangia not deciduous; **resting spores** not observed.

Saprotrophic; after 15-30 days appearing as small pustules on the surface of *Rosa* sp. fruits used as bait.

Holotype: ARGENTINA. **Buenos Aires Province:** Berisso, Channel 66 (artificial channel), in water with floating vegetable debris and organic pollution, June 2003, *Paula Hualde* (LPS N° 472171), dried material deposited at Spegazzini Institute.

Discussion

Of the 31 described species, our new Argentine species appears similar in its habit to *Blastocladia pringsheimii*, *B. globosa*, *B. ramosa*, *B. sparrowii*, *B. fruticosa* S.N. Dasgupta & R. John, and *B. pileota* S.N. Dasgupta & R. John. Principal characters of these related species are detailed in Table 1. Among these species *B. bonaerensis* is unique because of their smooth or thick-walled, cylindrical or clavate basal cell, with dichotomously, umbellately, or irregularly arranged branches or swollen apices up to 400 µm. The whole thallus only reaches 575 µm in length. Setae can be present or scarce. The zoosporangia are characteristically sessile, obpyriform, with a prominent apical beak borne along the tips of the branches or over the surface of the swollen lobes; they can also be fusiform, cylindrical, naviculate and obovate. Resting spores are lacking.

Acknowledgments

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Table 1. Comparison of principal characters in *B. bonaerensis* and related species.

	<i>B. pringsheimii</i>	<i>B. globosa</i>	<i>B. ramosa</i>	<i>B. sparrowsii</i>	<i>B. fruticosa</i>	<i>B. pileola</i>	<i>B. bonaerensis</i>
Thallus size (µm)	up to 2,000	120-400	260-1,000	up to 620	150-250	up to 460	300-575
Basal cell size	400-1,000 X 30-90	120-350 X 200	up to 400 X 14-80	312-468 X 13-31	60-75 X 30-50	160-230 X 50-60	(175-) 225-320/(-354) X 50-80
Basal cell shape	cylindrical or clavate	globose or subglobose, with expanded distal portion	cylindrical	cylindrical with swollen distal portion	cylindrical	cylindrical	cylindrical or clavate
Basal cell branching	dichotomous, umbellate or irregularly with swollen apices	unbranched or with expanded lobes	dichotomously (2-several axes branched sympodial or irregularly)	lobed or not	dichotomously (2-several axes branched sympodial or irregularly)	dichotomously (3-4 axes branched dichotomously once or twice)	dichotomous, umbellate or irregularly
Zoosporangial shape	cylindrical or narrowly clavate, ellipsoidal, fusiform, long ovoid or siliquiform	cylindrical or broadly cylindrical	ovoid, with a narrow truncate base or broadly fusiform	cylindrical, with internal proliferation	pyriform or cylindrical	ovoid, pitcher-shaped with a neck ending	obpyriform, with a prominent beak; sometimes fusiform, cylindrical, naviculate & obovate
Zoosporangio- size (µm)	70-350 X 13-70	55-160 X 15-60	30-85 X 7-24	73-143 X 13-31	28-30 X 15-17 (pyrif.)/25-30 X 9-10 (cylind.)	40-68 X 20-30	(25-) 32-75 X 17-37
Resting spore shape	ellipsoidal, ovoidal or spherical	subspherical, ovoid or subpyriform	broadly ovoid, narrowly clavate or spatulate	lacking	spherical or ovoid	lacking	lacking
Resting spore size (µm)	40-99 X 30-50	25-70 X 27-50	18-38 X 11-28		15-25/20-22 X 17		
Setae	scarce or absent	scarce or absent	lacking	present, branched or not	lacking	lacking	scarce or absent

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New species and combinations in *Cortinarius* subgenus *Phlegmacium* section *Calochroi*

TOBIAS GULDBERG FRØSLEV

tobiasgf@bi.ku.dk

*Department of Microbiology, Institute of Biology, University of Copenhagen
Øster Farimagsgade 2D, DK-1353 Copenhagen K, Denmark*

TOR ERIK BRANDRUD

tor.brandrud@nina.no

*Norwegian Institute for Nature Research
P.O. Box 736 Sentrum, N-0105 Oslo, Norway*

THOMAS STJERNEGAARD JEPPESEN

thomas@stjernegaard.net

*Botanical Museum
Gothersgade 130, DK-1123 Copenhagen K, Denmark*

Abstract — Based on morphological and molecular phylogenetic studies we present two new species and one new combination in *Cortinarius*. Species descriptions are provided, along with discussions of phylogenetic and morphological affinities to similar taxa. All species belong to section *Calochroi* (incl. section *Fulvi* and *Laeticolores* s. auct.). *Cortinarius osloensis* and *Cortinarius piceae* spp. nov. are described, and *Cortinarius barbaricus* comb. nov. is introduced. The first taxon is a fulvoid species (i.e. contain anthraquinonoid pigments), and the two latter are calochroid (non-anthraquinonoid). *Cortinarius piceae* is described to cover the species most often treated as *Cortinarius calochrous* var. *coniferarum*.

Keywords — taxonomy, ectomycorrhizal fungi

Introduction

Species level taxonomy for the species traditionally treated in *Cortinarius* subgenus *Phlegmacium* section *Calochroi* (incl. *Fulvi* and *Laeticolores*) is difficult, and controversy exists both relating to the number and status of taxa

and the application of names. Until recently, the species level taxonomy has almost entirely relied on gross morphology and ecology, and has not resulted in a broadly acceptable consensus taxonomy. The inclusion of more anatomical characters in taxonomical studies have proven valuable for establishing a more coherent taxonomy for several groups of *Cortinarius* (Brandrud 1996a, Brandrud 1996b, Brandrud 1998, Melot 1990). More recently DNA sequence data have been employed in studies of phylogeny and taxonomy in diverse groups of Agaricales. Many studies of *Cortinarius* have employed phylogenetic analyses of nuclear ribosomal gene sequence data (Frøslev et al. 2005, Garnica et al. 2003a, Garnica et al. 2003b, Garnica et al. 2005, Høiland & Holst-Jensen 2000, Kytövuori et al. 2005, Liu et al. 1997, Moser & Peintner 2002, Peintner et al. 2001, Peintner et al. 2002, Peintner et al. 2004, Peintner et al. 2003, Seidl 2000). However, most of these included few collections within species.

Frøslev et al. (unpublished) identified independently evolving lineages in the section *Calochroi* by phylogenetic inference and comparison of ITS sequences from more than 400 collections, which represent most of the known European morphological, geographical and ecological diversity. More than 70 independently evolving lineages were identified, and the majority of these lineages comply with a morphological species concept (including pigment characters and ecological characters). Seven of these have already been described as new (Frøslev et al. 2006). Further two species are here described as new, and one taxon is being given specific rank.

Material and methods

The taxonomic descriptions are primarily based on the material studied by the authors. The measurements of macro morphological characters are based on expanded, but never old (and then often aberrant) basidiocarps. Macro chemical reagents applied were 2% and 40% KOH. The terminology of characters follows Brandrud et al. (1990) with minor adjustments (see Brandrud 1996a). Microscopical structures were observed partly from fresh material mounted in H₂O, often with a drop of 40% KOH subsequently added, and partly from dried material mounted in H₂O and then KOH. The descriptions of the pigment topography are based largely on observations from H₂O mounts of fresh, preferentially young material. The spores were studied and measured in 2 % KOH, with a 100 x oil immersion lens. From each basidiocarp, a random selection of mature spores obtained from cortina remnants were measured excluding apiculus and ornamentation. Young, immature basidiocarps were avoided. For species with a lot of available specimens ten spores were measured per specimen. For species with few available collections thirty or more spores were measured per specimen. Mean values (MV) of spore length and width as

well as Q-values (length/width ratio) were then calculated for each specimen. MVs for each taxon were calculated. The pileipellis was studied from radial (longitudinal), free hand sections, preferentially from fresh material. Wedge-like sections, ultra thin at the one end, were obtained by cutting at a slightly oblique angle. The sections were cut from c. 5 x 5 x 3 mm large pieces taken from young but expanded pilei, and at a position midway to the centre. Methanol extractable, anthraquinonoid pigments of *C. osloensis* were investigated by thin layer chromatography (TLC), from dried material, and developed in a water-saturated solvent-mixture of ethyl formate:formic acid:toluene (50:15:35) on silica gel aluminum plates. ITS sequence data of the holotype of *C. osloensis* (GenBank accession: DQ996975) was amplified and sequenced for this study according to the methods in Frøslev et al. (2005).

The species treated here are phylogenetically well delimited and the phylogenetic separation as indicated by the analyses of Frøslev et al. (unpublished) is discussed. Herbarium acronyms follow Holmgren et al. (1990). The following acronyms are used in collection numbers DB=Balint Dima, TEB=Tor Erik Brandrud, TF=Tobias Guldberg Frøslev and TSJ=Thomas Stjernegaard Jeppesen. All mentioned binomials (unless otherwise indicated) correspond to species that were identified in the study by Frøslev et al. (unpublished) and can be delimited by morphological characters. Colour photographs of most species and many of the collections cited here are available on www.cortinarius.com (Frøslev & Jeppesen 1999-2006).

Taxonomic descriptions

Cortinarius osloensis Brandrud, T.S. Jeppesen & Frøslev, sp. nov.

Mycobank: 510236

Pileo 30–60 mm lato, hemisphaerico, dein plano-convexo, glutinoso, a centro ochraceo-brunneo, ad marginem ochraceo-luteo, KOH ope sub-nullo. Velo universale sparso, pallido. Lamellis emarginatis, pallide luteis. Stipite in juventute albido-luteo dein albido, bulboso, bulbo distincte marginato. Facie externa mycelioque alba, KOH ope nullo. Velo partiale albido. Caro albida, odor ingratus, KOH ope nullo. Sporis limoniformibus, grosse verrucosis, 11–12.5 x 6.5–7.5 µm. Typus: NORWAY: Oslo: Bygdøy, Reinsdyrlia, TEB 559-04 (holotype O, isotype S).

Pileus 3–6(–7) cm, (hemi-)spherical, then plano-convex, glutinous, glabrous and glossy, dull when dry, and centre then sometimes slightly appressed tomentose; often distinctly bicolorous, outer half ochre yellow, centre ochre brown, the involute margin whitish yellow when (very) young, soon ochraceous, colours otherwise changing little with age. Universal veil remnants fairly sparse, sometimes leaving some whitish, large, diffuse, patches at centre, darkening with age. **Lamellae**, L = 60–90, crowded, 3–6 mm broad, pale yellowish, straw yellow (K 80–85) to greyish yellow, sometimes with a faint greenish yellow tinge

towards edge, soon ochre yellow, edge often distinctly crenulate-serrulate. **Stipe** 4–6 x 0.8–1.2(–1.5) cm, with a marginate bulb (up to 3 cm), whitish yellow when (very) young, then whitish, with age tinged ochre yellow from base. Universal veil on the bulb margin sparse to fairly abundant and volva-like, slightly viscid, when young yellowish to yellowish white at bulb margin, with age slightly brownish. Cortina fairly abundant, whitish. Basal mycelium usually sparse, white, sometimes with yellowish white mycelial strands. **Context** when young whitish with greyish yellow tinged hygrophanous spots in stipe apex, with age sometimes spotted with brown in the bulb, sometimes saffron brown where eaten by snails. **Macrochemical reactions:** 2% and 40% KOH negative (pale brownish) in context, sometimes faintly vinaceous grey on pileus when very young. **Smell** distinctly raddish-like, earth-like to dust-like, strong with age, especially on the lamellae. **Taste** raddish-like. **Dried material** ochre brown.

Extractable pigments: Small to (in pileipellis) moderate amounts of the greenish yellow flavomannin-6,6',8-trimethylether.

Spores 11–12.5 x 6.5–7.5 μm (MV = 11.85 x 7.18 μm), Q = 1.65 (n=130, 13 specimens), citriform, very distinctly and coarsely verrucose, suprahilar plague more or less distinct. **Basidia** 9–11 μm wide, 4-spored, some with yellowish content; some pigment from exsiccates purplish with KOH. **Lamella edge** more or less fertile, with some indistinct, clavate-cylindrical sterile cells. **Lamella trama** of (3–)4–20 μm wide, mainly hyaline hyphae, some hyphae (especially of subhymenium) with initially dissolved, cytoplasmatic, then intracellular, yellowish granular pigment. **Universal veil** on pileus in patches of ca. 5–10 layers, hyphae 3–5(–6) μm wide (up to 8 μm at centre), mainly hyaline, some with intracellular, yellow granules or more yellow brown confluent-diffracted to oleiferous pigment, some very finely verrucose with KOH; veil on the bulb margin of 2–5(–8) μm wide hyphae, some hyphae with yellowish, granular to oleiferous pigment. **Pileipellis** simplex: Cutis thick, of ca. (20–)25–30 hyphal layers. At surface ca. 5–10 gelatinous layers of (2.5–)3–5 μm wide, loosely erect-entangled hyphae, hyaline or sometimes with pale yellow, refractive, cytoplasmatic pigment, some collapsed terminal hyphae with yellow, oleiferous pigment. The basal part of cutis of 15–25, parallel to slightly interwoven hyphal layers, hyphae (3–)4–7(–9) μm wide, partly in subparallel, $\pm$ interconnected bundles; pigment mainly intracellular, initially pale (greenish) yellow, dissolved in cytoplasm, then yellow brown, granular, with KOH oleiferous; some hyphae with faintly verrucose, yellow walls with KOH; some extracellular granules observed on young specimens; pigment from exsiccates usually yellowish brown with KOH. **Trama** $\pm$ hyaline. **Mycelial strands** of 3–5 μm wide, entangled-subparallel hyphae at surface, up to 12(–15) μm wide and parallel hyphae centrally, hyphae hyaline, sometimes with (greenish) yellow,

intracellular, granular pigment, hyaline, diffractive, extracellular granules occur scattered.

Ecology and distribution: Boreo-nemoral to montane deciduous forests. Associated with *Tilia cordata* and probably also *Corylus avellana* on shallow, dry, calcareous soil with little or no humus and leaf litter, including more or less unstable scree soil on slopes. Growing under large *Tilia cordata* trees, and a connection by mycelial strands to *T. cordata* mycorrhizas has been observed. Extremely rare. Known only from two localities in the innermost Oslofjord area, Bygdøy within Oslo (including two different, but closely situated forests) and Ringerike area (Bendiksen et al. 1998), both localities being extremely rich in rare and endangered species of *Phlegmacium*. The species is included in the red data list of Norway as critically endangered (cf. Bendiksen et al., 1998; new red list in prep.).

Specimens studied – (*including macro characters): NORWAY: OSLO: Bygdøy, Reinsdyrlia, 26 Sept. 2004, T.E.B., TEB 559–04* (holotype, herb. O, isotype herb. S); loc. cit., 5 Oct. 2004, T.E.B., TEB 608–04 (herb. O); Bygdøy, Dronningberget T.E.B., TEB 506–80* (herb. O); loc. cit., 12 Sept. 1982, T.E.B., TEB 199–82* (herb. O); loc. cit., 21 Aug. 1992, T.E.B., TEB 18–92* (herb. O); loc. cit., 16 Aug. 1993, T.E.B., TEB 36–93* (herb. O); loc. cit., 20 Aug. 1993, T.E.B., TEB 49–93* (herb. O); loc. cit., 23 Sept. 1994, T.E.B., TEB 93–94* (herb. O); loc. cit. 21 Sept. 2005, T.S.J. & TEB., TSJ2005–026* (herb. C). BUSKERUD: Hole, Nes, 11 Sept. 1985, T.E.B., TEB 268–85* (herb. O); loc. cit., 31 Aug. 1993, T.E.B., TEB 96–93* (herb. O); loc. cit., 11 Sept 1994, T.E.B., TEB 41–94* (O), loc. cit., T.E.B., TEB 42–94*.

Comments — *Cortinarius osloensis* is characterized by its small basidiocarps, earth-like smell and its ochre yellow colours without any greenish yellow or olivaceous tinges. The species looks like a *C. calochrous* with yellowish lamellae. *Cortinarius osloensis* resembles *C. humolens* Brandrud (= *C. claroflavus* sensu M.M. Moser) and was included in the description of *C. claroflavus* sensu M.M. Moser by Brandrud (Brandrud 1982). *C. humolens* possess the same radish or earth-like smell and taste as *C. osloensis*, but differs by its larger basidiocarps, smaller spores, often greenish yellow or olivaceous tinges on the pileus and veil, more coloured stipe, a larger, more flattened bulb, a more pronounced saffron discolouring in insect damaged tissue, a partly different KOH-reaction and smaller spores. *Cortinarius humolens* furthermore occurs in organic soils, mainly in forests with deep leaf litter with *Quercus ilex* and more rarely *Fagus sylvatica*. Young specimens of *C. langeorum* Frøslev & T.S. Jeppesen have a pileus colour similar to that of *C. osloensis* and the spore size and shape are very similar between the two species. *C. langeorum* differs, however, by a deep red-brown to dark red reaction on pileus with KOH, by the greyish lamellae without any yellow pigmentation and by the (greenish) yellow bulbipellis. *Cortinarius osloensis*, *C. alcalinophilus* (darker pileus, yellow context) and *C. olearioides* (with saffron-orange tinges) are the only species among the (greenish)

yellow-gilled, anthraquinone pigment-containing taxa of *Phlegmacium* (sect. *Fulvi*) which normally lack greenish or olive tinges. The main pigment in *C. osloensis*, flavomannin-6,6',8-methylether, is greenish yellow, but it occurs in low amounts in the basidiocarps, and the greenish tinge apparently somehow becomes masked by other pigments, although such additional pigments are not apparent from microscope examination nor by TLC-extraction.

Phylogenetic analyses based on ITS, RPB1 and RPB2 data (Frøslev et al., unpublished) place *C. osloensis* as a sister taxon to a small group containing *C. saporatus* Britzelm. and *C. caroviolaceus* P.D. Orton in a well-supported lineage of non-anthraquinoid and pigment poor species also including *C. pseudoglaucopus* (Jul. Schäff. ex M.M. Moser) Quadr. and *C. humolens*, which is morphologically similar to *C. osloensis*. More than 25 nucleotide differences in the ITS region separates *C. osloensis* from these related species. Based on the main pigment, flavomannin-6,6',8-methylether, *C. osloensis* and *C. humolens* were placed in subsection *Elegantiores* along with *C. alcalinophilus*, *C. elegantior*, *C. quercus-ilicis*, *C. murellensis* (listed as *C. balearicus* ined.), *C. olearioides* and *C. splendidicus* (Brandrud 1998). These latter species, however, form an evolutionary separate lineage and share the presence of flavomannin-dimethylether not found in *C. osloensis* and *C. humolens*.

Cortinarius osloensis is recorded in mixed stands of *Tilia cordata* and *Corylus avellana*, dominated by *Tilia* (Oslo and Hole). *Tilia* and possibly *Corylus* seem to be the preferential hosts of this species. With present knowledge, *C. osloensis* appears to be one of the rarest species of *Phlegmacium* having been found only within the Oslofjord area in Norway.

The type locality of *C. osloensis* (Oslo, Bygdøy) has been studied yearly 1979–1998, and most of the succeeding years. Basidiocarps of the species have appeared irregularly confined to the moist years 1980, 1982, 1992, 1993, 1994, 1997, 1999, 2004, 2005 (9 out of 28 years), fruiting from 5–6 different mycelia.

An ITS sequence of the holotype of *C. osloensis* (TEB 559–04) is available on GenBank (accession DQ996975)

***Cortinarius piceae* Frøslev, T.S. Jeppesen & Brandrud, sp. nov.**

Mycobank: 510237

Pileo 30–60 mm lato, hemisphaerico, dein plano-convexo, glutinoso, primo luteo, dein a centro ochraceo-luteo vel brunneo, centro e velo brunneo maculato, KOH ope brunneo. *Velo* universale albido-luteo vel luteo-brunneo. *Lamellis* emarginatis, pallide violaceis. *Stipite* in juventute albido dein albido-luteo, bulboso, bulbo distincte marginato. *Facie externa* mycelioque alba, KOH ope nullo. *Velo partiale* albido. *Caro* albida, odor sub-nullo, KOH ope nullo. *Sporis* amygdaliformibus, grosse verrucosis, 9.5–11 x 6–7 µm. *Typus*: SWEDEN: Västergötland: Gössäter, TF2004-026 (holotype C).

Pileus 3–6(–7) cm, (hemi-)spherical, then plano-convex, glutinous, glabrous and glossy, dull when dry, and centre then sometimes slightly appressed tomentose, yellow, Universal veil leaves small brownish to blackish spots especially at centre, towards margin more diffusely brownish in streaks, the involute margin yellow. **Lamellae** crowded, pale violaceous to almost grey, soon ochre (-violaceous). **Stipe** 4–6 x 0.7–1.2 cm, with a marginate bulb (up to 2.5 cm), whitish when young, then more or less yellowish to brownish. Universal veil on the bulb margin sparse to fairly abundant, slightly viscid, when young yellowish to yellowish white at bulb margin, with age slightly brownish. Cortina fairly abundant, whitish. Bulbipellis white. **Context** when young whitish with pale brownish tinged hygrophanous spots and stripes in stipe apex, later whitish. **Macrochemical reactions:** 2% and 40% KOH negative (pale rose-brownish) in context, distinctly brownish (not red or pink) on pileus, negative on bulbipellis. **Smell** earth/dust like. **Taste** indistinct. **Dried material** yellowish on pileus, otherwise pale brownish.

Spores 9.5–11 x 6–7 μm (= 10.3 x 6.4 μm), $Q = 1.62$ ($n=140$, five specimens), amygdaliform, distinctly and coarsely verrucose, suprahilar plague more or less distinct. **Basidia** 9–11 μm wide, 4-spored. **Lamella edge** more or less fertile. **Lamella trama** of (3–)4–20 μm wide, mainly hyaline hyphae. **Pileipellis** simplex: Cutis thick, of ca. 25 hyphal layers. At surface ca. 5–10 gelatinous layers of ca. 4 μm wide, loosely erect-entangled hyphae, hyaline. The basal part of cutis of ca. 20, parallel to slightly interwoven hyphal layers, hyphae ca. 5 μm wide. **Trama** $\pm$ hyaline.

Ecology and distribution — *Cortinarius piceae* occurs in boreo-nemoral, montane and subalpine coniferous forests. Associated with *Picea abies* and *Abies alba*. On calcareous, dry to seasonally moist soil. *Cortinarius piceae* is rare, but one of the more common calochroid species in calcareous coniferous forests, and is widely distributed in suitable habitats throughout Europe.

Specimens studied – (*including macro characters): ITALY: TRENTO: Trentino-Alto Adige, Diga di Paneveggio, 28 Sept 2001, G. Consiglio, P. Ceccon & S. Pedergnana (herb Cons.). — NORWAY: OPPLAND: Lunner, 23 Sept 2006, T.E.B., T.S.J. & T.F., TF2006-120* (herb C); loc. cit., 24. Sept 2006, T.E.B., T.S.J. & T.F., TF2006-121* (herb C). — SWEDEN: Västergötland, Kinnekulle, Gössäter, 11 Sept. 2004, T.S.J. & T.F., TSJ2004-006* (herb C); loc.cit., 23 Sept. 2004, T.S.J. & T.F., TSJ2004-020* (herb. C); loc. cit., TF2004-025* (herb C); loc. cit., TF2004-026* (holotype herb C); loc. cit., Medelplana, 16 Sept 1986, T.E.B., H. Lindström, H. Marklund, J. Melot & S. Muskos, CFP508* (herb S)

Comments — *Cortinarius piceae* is characterized by the warmly yellow colours on the pileus, which becomes darker brownish yellow, very pale violaceous colours of the lamellae, a pale stipe, and a brownish alkaline reaction on the pileus and a negative reaction on the bulbipellis. It is separated from most other co-occurring calochroid species by the thoroughly coloured pileus (including

the margin) and the non-pink alkaline reaction of bulbipellis and pileus. *C. barbarorum* Bidaud et al. and *C. barbaricus* differ by a lighter and persistently yellowish coloured pileus with larger (or lacking) and paler velum scales, more pronounced violaceous colours of stipe and/or lamellae, and a strongly pinkish red alkaline reaction on the pileus and a pink alkaline reaction on the bulbipellis. Generally the basidiocarps of *C. piceae* are smaller.

Phylogenetic analyses based on ITS, RPB1 and RPB2 (unpublished data) place *C. piceae* as a weakly supported sister species to *C. dalecarlicus* Brandrud with which it share several morphological and ecological characters. They are separated consistently separated by 18 nucleotide differences. Despite morphological resemblance, it is not closely related to neither *C. barbarorum* nor *C. barbaricus* (unpublished data).

The species described here corresponds to the taxon often treated as a variety of *C. calochrous* – i.e. *C. calochrous* var. *coniferarum* (M.M. Moser) Quadr. (e.g. in Brandrud et al. 1990). Molecular phylogenetic studies and morphology, however, indicate that this taxon should be treated as an independent species. For several reasons we chose to describe the taxon as a new species not connected to the type of *Phlegmacium calochroum* var. *coniferarum* M.M. Moser. First of all, it seems that the description of Moser (1960) covers both *C. piceae* and at least one other calochroid coniferous forest taxon (i.e. *C. barbarorum* or *C. barbaricus*). These taxa are impossible to unambiguously morphologically identify from exsiccates and DNA amplification of old type material (the type is from 1948) is difficult (and we have not been able to obtain the type from München for study). Secondly, the name *C. coniferarum* is preoccupied by a taxon in the *C. multiformis* group (i.e. *Phlegmacium multiformis* var. *coniferarum* M.M. Moser = *Cortinarius coniferarum* (M.M. Moser) Moëgne-Loec. & Reumaux), so the introduction of a nomen novum is inevitable. Thirdly, the name *C. barbarorum* was introduced by Bidaud et al. (2001) intended as a new name for *Phlegmacium calochroum* var. *coniferarum*, but a new type was deposited and the basionym not cited, and the description must thus be treated as covering a new species not connected to the type of *P. calochroum* var. *coniferarum*. Looking at the illustrations of *C. barbarorum* in Bidaud et al. (2001), it is evident that more than one species is illustrated, among these also *C. piceae*. The type of *C. barbarorum*, however, belongs to another species than *C. piceae* (unpublished data). Thus we chose to describe the taxon as a new species.

Cortinarius homomorphus Kühner was published invalidly by Kühner (1960) and later validated (Kühner 1989). Kühner describes a species with a yellow pileus with darker scales, violaceous lamellae, a pronounced violaceous stipe, violaceous context in the stipe, and a brown-red KOH reaction. The description combines characters of *C. barbarorum*, *C. barbaricus* and *C. piceae* with those

of *C. haasii* (M.M. Moser) M.M. Moser. Kühner emphasizes the violaceous stipe, which hardly correspond with *C. piceae* but rather *C. haasii*. He states that he knows the species from both coniferous forest and beech forest, but current knowledge indicates that no calochroid species grow with both frondose trees and conifers. The epithet was (originally) introduced at a time where the concept of *C. calochrous* covered at least 15 species, and the possibility that Kühner's description covers at least two species is great. The type specimen consists of a few small fragments, and DNA extraction of the type has not succeeded yet (Frøslev et al., unpublished). The epithet has rarely been used and despite a very thorough description in Kühner (1960) it presently seems difficult to unambiguously apply to any of the presently recognized species. Bidaud et al. (2001) applied the name *C. homomorphus* (and also *C. pansa*) for the species they describe as *C. barbarorum* in the same publication (unpublished data). Further molecular studies would be needed to clarify if the type specimen of *C. homomorphus* represents an older epithet for e.g. *C. barbarorum* or more likely a junior synonym of *C. haasii*.

An ITS sequence of the holotype of *C. piceae* (TF2004-026) is available on GenBank (accession DQ663378).

Cortinarius barbaricus (Brandrud) Frøslev, T.S. Jeppesen & Brandrud, **comb. nov.**

Basionym: *Cortinarius calochrous* var. *barbaricus* Brandrud, in Cortinarius, Flora Photographica 3: 27 (1994). Holotype: CFP504 (herb S).

Comments — Phylogenetic analyses (Frøslev et al., unpublished) have shown that this taxon is well separated from other resembling calochroid species, and thus deserves to be treated at specific rank. The three specimens of *C. barbaricus* sequenced are identical in the ITS region, and it is placed as a sister species to *C. barbarorum* from which it is separated by 12 nucleotide differences in the ITS region. The two species are morphologically almost inseparable. It seems that *C. barbaricus* has a more distinct yellow cap colour than *C. barbarorum*, and a more violaceous colouration of the stipe (apex), and a more distinct colouration of the stipe than lamellae, which is opposite for *C. barbarorum*. The smell of *C. barbaricus* is mild and somewhat like *C. sulphurinus* Quél. (i.e. parsley), whereas *C. barbarorum* has a stronger and more unpleasant smell of dust/earth. Further morphological and phylogenetic studies are needed to find unambiguous morphological differences between these species.

The more common and widespread *C. piceae* differs by a more coloured pileus with small brown spot like scales, (almost) colourless lamellae and almost negative KOH reactions, and is phylogenetically well separated from the two other taxa.

An ITS sequence of the holotype of *C. barbaricus* (CFP504) is available on GenBank (accession DQ663234).

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A new species and a new Chinese record of *Exobasidium* (*Exobasidiales*) from China

ZHENYING LI^{1,2} & LIN GUO^{1*}

lizheny@mails.gucas.ac.cn **guol@sun.im.ac.cn*

¹Key Laboratory of Systematic Mycology and Lichenology
Institute of Microbiology, Chinese Academy of Sciences
Beijing 100080, China

²Graduate University of Chinese Academy of Sciences
Beijing 100049, China

Abstract—A new species, *Exobasidium lyoniae* causing leaf spots on *Lyonia ovalifolia* var. *lanceolata* and a new Chinese record, *Exobasidium euryae* on *Camellia oleifera* are reported. The new species was collected from Yunnan Province, China. The new record was discovered from Hunnan Province, China. The new species is characterized by the number of sterigmata and the size of basidiospores.

Key words—Ustilaginomycetes, symptom, taxonomy

A new species of *Exobasidium* on *Lyonia ovalifolia* var. *lanceolata* was collected from Tengchong, Yunnan Province in 2005. The new species is parasitic on young leaves, causing leaf spots, usually one and sometimes more on each leaf, 5–12 mm in diameter, red above and white with hymenium beneath. The transverse section of the diseased leaf shows no differentiation between the palisade and mesophyll cells. There is not hypertrophy or hyperplasia of plant cells. Intercellular hyphae protrude between epidermal cells, forming a continuous layer on the undersurface of the leaves at maturity. This recently collected *Exobasidium* species has 2–5 sterigmata, and its basidiospores measure (9–)10–15(–16) x 2.8–4.5 µm. When comparing the morphology of the validly described taxa on *Ericaceae* plants, *Exobasidium pieridis-ovalifoliae* (Ezuka 1991) on *Lyonia ovalifolia* var. *elliptica* (Siebold & Zucc.) Hand.-Mazz. shows similarities on the symptom and the number of septa of basidiospores. The new species is different from *E. pieridis-ovalifoliae* in the number of sterigmata and size of basidiospores, the latter having 2–3(–4) sterigmata and basidiospores measuring 15–20(–22) x 4–6.5 µm.

*corresponding author

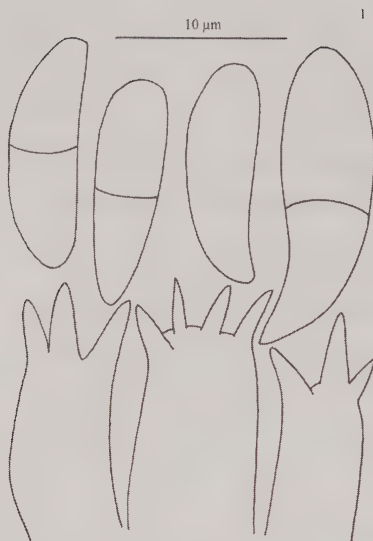


Fig. 1. Basidia, sterigmata and basidiospores of *Exobasidium lyoniae* on *Lyonia ovalifolia* var. *lanceolata* (HMAS 140551, holotype).

***Exobasidium lyoniae* Z.Y. Li & L. Guo, sp. nov.**

Figs. 1, 3-5

MYCOBANK MB510328

Hymenium hypophyllum. Basidia hyalina, clavata vel cylindrica, $34\text{--}50 \times 5\text{--}7\text{--}(8) \mu\text{m}$, terminaliter 2–5 sterigmatibus $(2\text{--})3\text{--}5 \times 1\text{--}1.5\text{--}(2) \mu\text{m}$ praedita. Basidiosporae ellipsoideae vel curvae, $(9\text{--})10\text{--}15\text{--}(16) \times 2.8\text{--}4.5 \mu\text{m}$, hyalinae, laeves, primo continuae, dein 1–3-septatae.

Hymenium hypophyllous and white. Basidia with 2–5 sterigmata, clavate or cylindrical, $34\text{--}50 \times 5\text{--}7\text{--}(8) \mu\text{m}$. Sterigmata, conical, $(2\text{--})3\text{--}5 \times 1\text{--}1.5\text{--}(2) \mu\text{m}$. Basidiospores ellipsoidal, $(9\text{--})10\text{--}15\text{--}(16) \times 2.8\text{--}4.5 \mu\text{m}$, hyaline, smooth, at first continuous, then 1–3-septate, and slightly curved.

Specimen examined—On *Lyonia ovalifolia* var. *lanceolata* (Wall.) Hand.-Mazz. (*Ericaceae*), Yunnan: Tengchong, Xiaodifang, alt. 2180 m, 19 IX 2005, Z.Y. Li, L. Guo & N. Liu 206, HMAS 140551 (holotype).

A new Chinese record of *Exobasidium* on *Camellia oleifera* was collected from Hunan Province in 2005. This species is parasitic on the apical buds causing deformation and forming a peach-like hollow gall with spongy texture, measuring 30–50 mm in diameter. When maturing the hymenium sloughed off the epidermis and exposed outside. The hymenium is white, continuous, and the hyphae are intercellular. Transverse section of the diseased bud shows hypertrophy and hyperplasia of plant cells and there is no differentiation

between the palisade and mesophyll cells. The species causing bud galls on *C. oleifera* was identified as *Exobasidium camelliae* by Yang (in Siang 1957), as *E. vexans* by Liu et al. (2002) and as *E. gracile* by Wang et al. (2004). But *E. camelliae* has bigger basidiospores of $15\text{--}25 \times 5\text{--}7.5 \mu\text{m}$, *E. vexans* causes only leaf spots and has only 2 sterigmata, *E. gracile* causes only leaf hypertrophy and its colony was smooth and composed of conidia only. The species causing bud galls was identified as *E. euryae* (Sydow et al. 1912) which is new to China. *E. euryae* was first reported to cause hollow bud galls of *Eurya acuminata* DC. from Katmandu, Nepal, having 2-4 sterigmata and basidia measuring $60 \times 5\text{--}10 \mu\text{m}$, basidiospores $14\text{--}17 \times 4 \mu\text{m}$.

Exobasidium euryae Syd., P. Syd. & E.J. Butler, Ann. Mycol. 10: 275, 1912.

Figs. 2, 6-8

Basidia with 2-4 sterigmata, clavate or cylindrical, $101\text{--}138(\text{--}151) \times 5\text{--}11 \mu\text{m}$. Sterigmata conical $2\text{--}4 \times 1\text{--}2 \mu\text{m}$. Basidiospores are obovoid, subclavate or musiform, $(10\text{--})12\text{--}17.6 \times 3\text{--}4.8 \mu\text{m}$, hyaline, smooth, at first continuous, then becoming septate with 1-4 septa, and slightly curved at the base. Germ tubes of the basidiospores emerge from both ends and septal regions of each cell. Conidia bud to produce daughter cells. Conidia, produced on PDA in 21 days incubation are linear, hyaline and measure $2\text{--}6 \times 0.5\text{--}1.2 \mu\text{m}$.

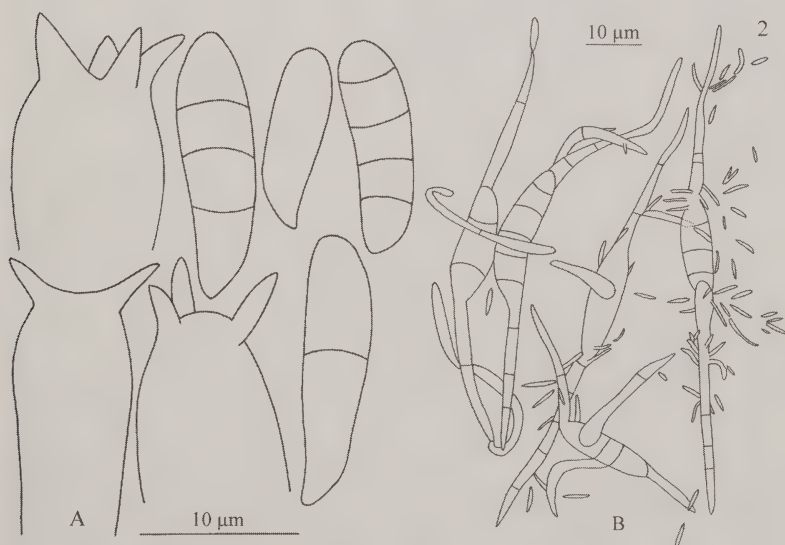


Fig. 2. *Exobasidium euryae* on *Camellia oleifera* (HMAS 97947).
A. Basidia, sterigmata and basidiospores. B. Basidiospore germination.

Colonies on PDA grew gradually, to a maximum 12 mm diameter in 21-day incubation at 25°C. The surface of the colony was yellow, corrugate and the periphery slightly wrinkled. Colonies did not fix on the agar surface. Formed conidia did not produce a powdery appearance. Colonies were composed of hyphae and conidia.

Specimen examined—On *Camellia oleifera* Abel (*Theaceae*), Hunan: Changde, Maoligangcun, alt. 50 m, 17 IV 2005, Z.Y. Li & L. Guo 2, HMAS 97947.

So far 20 species of *Exobasidium* have been recorded in China (Tai 1979, Sawada 1922, Li & Guo 2006). Three species are parasitic on *Lyonia* plants: 1) *Exobasidium lyoniae* causing leaf spots (in this paper), 2) *E. pieridis* Henn. causing hypertrophy and deformation, 3) *E. pieridis-ovalifoliae* Sawada causing leaf spots. Six species are parasitic on *Theaceae* plants: 1) *E. camelliae* Shirai causing hypertrophy of flower buds, foliar buds, leaves and fruits, 2) *E. euryae* causing hollow bud galls (in this paper), 3) *E. gracile* (Shirai) Syd. & P. Syd. causing hypertrophy of young leaves and shoots, 4) *E. monosporum* Sawada causing leaf spots, 5) *E. reticulatum* S. Ito & Sawada causing net-like leaf spots, 6) *E. vexans* Massee causing leaf spots.

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Figs. 3-5. *Exobasidium lyoniae* on *Lyonia ovalifolia* var. *lanceolata* (HMAS 140194, holotype). Fig. 3. Symptom. Fig. 4. Basidium and sterigmata as seen by LM (light microscopy). Fig. 5. Basidia, sterigmata and basidiospores as seen by SEM (scanning electron microscopy).

Figs 6-8. *Exobasidium euryae* on *Camellia oleifera* (HMAS 97947). Fig. 6 Symptom. Fig. 7. Colony cultured on Potato Dextrose Agar (PDA) for 21 days. Fig. 8. Basidia, sterigmata and basidiospores as seen by SEM (scanning electron microscopy).



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To our Readers

This volume of MYCOTAXON marks the end of our transition to a fully electronically submitted and prepared journal.

Part of that transition has been to streamline the journal's appearance without changing a format that has served it well for over thirty years. Color—which returned in January after a 20-year hiatus—continues to entice the reader's eye: note, for instance, Zhuang & Yang's macrophoto of a wood-loving *Agyrium* (96: 171) or Spain & al.'s stunning *Appendicispora* microphotos (this volume: 171, 175).

An informal meeting of MYCOTAXON Editors at IMC8 in Cairns determined a less eye-catching, but equally important, change: we agreed unanimously to increase primary text font size to 10-pt. (Typographical experts agree that 10-pt is optimal for MYCOTAXON's 11 × 17.5 cm print page.) Although this seemingly minor decision delayed volume 97's publication by over a month, we are quite confident that our readers will resoundingly approve the increased legibility of the printed page.

Despite such recent cosmetic innovations, however, MYCOTAXON cheerfully remains a text-heavy scientific journal. As such, we continue to foster taxonomic rigor and nomenclatural accuracy while encouraging erudite discourses more lengthy than those permitted by most modern scientific magazines.

While we do discourage needless repetition—a common editorial irritation being the needless duplication of a lengthy English technical description in Latin (in lieu of the more useful short Latin diagnosis)—our pages welcome well-considered exploration and syntheses of seemingly disparate parts in our pages. Who among us has not marveled over the keen insight of a Buller, who lived in a time without EDTA, electron microscopes, and hard-drives but who possessed that most precious scientific tool of all — a discriminating human brain?

Insights such as Buller's take both time and space to develop. MYCOTAXON encourages publication of more lengthy monographic studies and reflective treatises of a more philosophical nature. Hence, we have raised our annual 'free' page limit from 64 to 100 pages in anticipation of several exciting longer papers now in the early stage.

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Lorelei L. Norvell, EDITOR-IN-CHIEF
Pacific Northwest Mycology Service
6720 NW Skyline Boulevard
Portland, OR 97229, U.S.A.

Shaun R. Pennycook, NOMENCLATURE EDITOR
PennycookS@LandcareResearch.co.nz
Manaaki Whenua Landcare Research
Auckland, New Zealand

David L. Hawksworth
BOOK REVIEW EDITOR
MycosNova, Calle Aguilas 12
Colonia La Matichosa, Matadipino
E-28411 Madrid, Spain

Karen D. Gellelman
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510 Luke Blvd., Apt. 166
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U.S.A.

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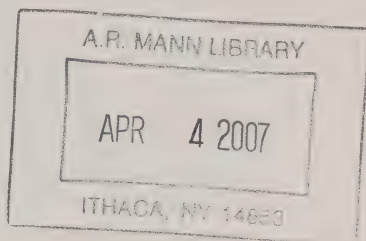
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EDITOR-IN-CHIEF

LORELEI L. NORVELL

editor@mycotaxon.com

Pacific Northwest Mycology Service

6720 NW Skyline Boulevard

Portland, Oregon 97229-1309 USA

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An index to Fries's *Epicrisis Systematis Mycologici*, 1838 1: Agaricini

S.R. PENNYCOOK

PennycookS@LandcareResearch.co.nz
Manaaki Whenua Landcare Research
Private Bag 92 170, Auckland, New Zealand

Abstract—All the generic, specific, and varietal taxa included under ‘Ord. I. Agaricini’ in Fries’s *Epicrisis Systematis Mycologici* are indexed and annotated with basionyms and other nomenclatural synonyms published before 1838. All names are provided with accurate authorities and publication dates. The index covers 20 genera: *Agaricus*, *Bolbitius*, *Cantharellus*, *Coprinus*, *Cortinarius*, *Gomphidius*, *Hygrophorus*, *Lactarius*, *Lentinus*, *Lenzites*, *Marasmius*, *Montagnites*, *Nyctalis*, *Panus*, *Paxillus*, *Russula*, *Schizophyllum*, *Stylobates*, *Trogia*, and *Xerotus*.

Key words—nomenclature, hymenomycetes, gilled basidiomycetes

Introduction

Epicrisis Systematis Mycologici (Fries 1838) is a major publication in which Elias Fries presented his first comprehensive revision and overview of hymenomycetous fungi subsequent to the early volumes of his sanctioning works (Fries 1821, 1822, 1832). *Epicrisis* adds greatly to the taxa recognised in the sanctioning works, by including: (i) taxa omitted from the sanctioning works; (ii) taxa relegated to synonymy in the sanctioning works but subsequently recognised as distinct; (iii) new taxa described by Fries and other authors in the intervening years; and (iv) taxa newly described in *Epicrisis*. Among these newly described taxa are three new genera (*Bolbitius*, *Grandinia*, *Panus*) and five new infrageneric ‘tribes’* (*Agaricus* ‘trib.’ *Entoloma*, *Panaeolus*, *Pluteus*, *Psathyrella*; *Cortinarius* ‘trib.’ *Hydrocybe*).

An *Index Dispositionis Hymenomycetum* (Fries 1838, pp. 595–608) lays out the classificatory scheme on which *Epicrisis* is organised; it indexes and provides

* Tribe (tribus) is defined by ICBN (Vienna) Article 4.1 (McNeill et al. 2006) as a suprageneric rank, lying between family and genus. Use of this name at any other rank is contrary to Article 33.10, with the sole exception [Article 33.12] of Fries’s use of *tribus* in his sanctioning works as an infrageneric rank below series. In *Epicrisis*, Fries (1838) did not explicitly name an infrageneric rank below series; therefore the taxa that he placed at this rank are validly published as names of unspecified rank [Article 35.3]. However, because the rank in *Epicrisis* equates with the rank *tribus* in the sanctioning works, for convenience I have indicated it in this index as ‘tribe’ or ‘trib.’ (omitting the quotation marks when referring to *tribus* names published in Fries 1821).

key diagnostic characters for all suprageneric, generic, and infrageneric taxa. Many taxa that the sanctioning works recognised under *Agaricus* are treated in *Epicrisis* as new combinations under segregate genera (*Bolbitius*, *Cantharellus*, *Coprinus*, *Cortinarius*, *Gomphidius*, *Hygrophorus*, *Lactarius*, *Lentinus*, *Lenzites*, *Marasmius*, *Nyctalis*, *Panus*, *Paxillus*, *Russula*, *Stylobates*, *Trogia*), and five “tribes” are transferred from *Agaricus* to *Cortinarius* (*Dermocybe*, *Inoloma*, *Myxaciium*, *Phlegmacium*, *Telamonia*).

The full scope of the taxonomic and nomenclatural contribution of *Epicrisis* is often overlooked in the literature, with many of its new species and new combinations incorrectly attributed to the much later *Hymenomycetes Europaei* (Fries 1874), the so-called 2nd Edition of *Epicrisis* (see below). A possible reason may be the contrasting accessibility of the contents of the two publications. Where *Hymenomycetes Europaei* has 49 pages of exhaustively comprehensive epithet indexes, *Epicrisis* has only a 1½-page Index Alphabeticus Generum (Fries 1838, pp. 609–610). For taxa that are included in both publications, the entry in *Epicrisis* can be simply found via *Hymenomycetes Europaei* cross-references to ‘Ed. I’. However, it is misleading to describe *Hymenomycetes Europaei* (Fries’s subtitle notwithstanding) as a 2nd Edition of *Epicrisis*. The scope of the two publications is very different. For example, *Epicrisis* treats five genera (*Agyrium*, *Crinula*, *Geoglossum*, *Midotis*, *Mitrula*) that were later recognised as out of place among the hymenomycetes, and not included in *Hymenomycetes Europaei*. Much more significantly, *Epicrisis* includes numerous taxa described from Asia, Africa, and the Americas, whereas *Hymenomycetes Europaei* excludes taxa not reported from Europe. Consequently, the descriptions of the many extra-European taxa in *Epicrisis* remain unindexed and difficult to find.

The purpose of this publication is to provide an annotated index to all the generic, specific, and varietal taxa accepted in *Epicrisis*. Names listed in synonymy in *Epicrisis* have not been indexed, but many of them are included in the annotations. No suprageneric and infrageneric taxa are indexed, except for “tribes” within *Agaricus* and *Cortinarius*. Part 1 of the index (published here) deals with ‘Ord. I. Agaricini’ (Fries 1838, pp. 2–408) including 20 genera: *Agaricus*, *Bolbitius*, *Cantharellus*, *Coprinus*, *Cortinarius*, *Gomphidius*, *Hygrophorus*, *Lactarius*, *Lentinus*, *Lenzites*, *Marasmius*, *Montagnites*, *Nyctalis*, *Panus*, *Paxillus*, *Russula*, *Schizophyllum*, *Stylobates*, *Trogia*, and *Xerotus*. Part 2 of the index (Pennycook 2007) deals with ‘Ord. II. Polyporei’, ‘Ord. III. Hydnei’, ‘Ord. IV. Auricularini’, ‘Ord. V. Clavariei’, and ‘Ord. VI. Tremellinae’ (Fries 1838, pp. 408–594).

Methods

Index entries and annotations

Main entries are listed alphabetically by epithet. To facilitate use of the index, species entries are formatted as ‘*epithet*, *Genus* [Author date]’ (e.g. *heterophylla*,

Russula [(Fr.) Fr. 1838]), and variety entries as ‘*epithet*, *Genus species* var. [Author date]’ (e.g. *galochroa*, *Russula heterophylla* var. [(Fr.) Fr. 1838]). For all taxa in *Agaricus* and *Cortinarius*, the “tribe” has been inserted in parentheses immediately after the generic name; in Fries’s text, the “tribe” name appears only as a heading, and is not included in the names of individual taxa. For all other genera, any index entry that includes an infrageneric name in parentheses is a direct transcription of an *Epicrisis* entry; for example, the taxon that Fries presented as: 18. L. (SCLEROMA) DESCENDENS is indexed as: *descendens*, *Lentinus (Scleroma)* [Fr. 1837]. All index entries are referred to the relevant page(s) in *Epicrisis*, cross-referenced to *Hymenomycetes Europaei* (abbreviated as ‘Hym. Eur.’), and annotated with basionyms and other nomenclatural synonyms published before 1838. Nomenclatural novelties first published in *Epicrisis* are presented in **bold type**, and their status is indicated as ‘sp. nov.’, ‘nom. nov.’, etc.

All names are provided with full authorities and dates (checked against the original sources, whenever possible), and sanctioned names are identified by inclusion of the standard tag ‘Fr.’ (but only for combinations at the sanctioned rank). When the publishing author ascribed a taxon to another author, the names of both authors are cited with a linking ‘ex’, except in the rare instances where there is explicit evidence that the ascription includes both the name and the description of the taxon (e.g. *Agaricus fritillariformis* Lasch 1838); otherwise, the lack of such unambiguous evidence makes strict application of ICBN (Vienna) Article 46 (McNeill et al. 2006) difficult, if not impossible.

Homonyms and invalid names are identified and annotated. Mistranscribed epithets and other typographic and grammatical errors appearing in *Epicrisis* have been corrected, annotated, and cross-referenced. For errors that occur in nomenclatural novelties the annotation is appended to the author citation; otherwise the annotation is appended to the corrected epithet. Similar errors in basionyms and synonyms are not cross-referenced but have been corrected, mostly without comment. Fries’s more extreme orthographic variants, mistranscriptions, and errors—e.g., *Agaricus cancrinus* as ‘*canerinus*’, *A. conopileus* as ‘*conopilus*’, *A. melanospermus* as ‘*melaspermus*’, *A. rhodocylix* as ‘*rhodocalyx*’, *Agaricus tessellatus* as ‘*tessulatus*’, *A. versicolor* as ‘*vebsicolor*’, *A. violaceofulvens* as ‘*violaceofulvus*’, *Boletus aereus* as ‘*aeneus*’, *Clavaria amethystea* as ‘*amethystina*’, *Clavaria vermicularis* as ‘*vermiculata*’, *Coprinus extintorius* as ‘*exstintorius*’, *Hericium stalactiticum* as ‘*stalactitium*’, *Hexagonia wightii* as ‘*wrightii*’, *Hygrophorus irrigatus* as ‘*irriguus*’, *Lactarius crampylus* as ‘*campylus*’, *Lentinus alopecia* as ‘*alopezinus*’, *Lentinus stupens* as ‘*stuppeus*’, *Marasmius caulicinalis* as ‘*cauticinalis*’, *Odontia barba-jobi* as ‘*barba-jovis*’, *Polyporus tessellatus* as ‘*tessulatus*’, *Polyporus verrucosus* as ‘*verruculosus*’, *Stereum frustulatum* as ‘*frustulosum*’—have all been treated as errors to be corrected; for some of them, an alternative treatment would be to interpret them as *nomina nova*.

The epithets of *Lenzites* species have all been corrected from feminine to masculine, following ICBN Article 62.4; however, I question the advisability of such an arbitrary negation of Fries's original gender assignment plus the unvarying usage of 170 years of mycological tradition.

Typographic interpretations

Taxa Fries prefixed with an asterisk (*) are interpreted as varieties of the preceding accepted (numbered) species; for example, the taxon Fries presented as: * *A. amsegetes* (following: 416. *A. vitilis*) is interpreted as: *Agaricus vitilis* var. *amsegetes*, and indexed as: *amsegetes*, *Agaricus (Mycena) vitilis* var. [Fr. 1838]. (The asterisked entries in *Epicrisis* have the epithet either in small capitals or in lower case italics; no speculative distinction has been made between these two typographies.) Interpretation of the asterisk as denoting a variety results in numerous names (e.g., *Agaricus cerussatus* var. *difformis*, *A. hypnorum* var. *bryorum*, *A. udus* var. *elongatus*) which correspond exactly with the names of taxa that Fries treated explicitly as varieties (prefixed by Greek letters) in the sanctioning works (Fries 1821, 1822). It also conforms with the instructions of ICBN (Vienna) Article 35.4 (McNeill et al. 2006); the asterisked names (of unspecified rank) are the sole category of formal infraspecific taxa in *Epicrisis*. There is no evidence that Fries was anticipating the later convention of employing an asterisk to denote the rank of subspecies.

Other taxa Fries prefixed with a dagger (†) are interpreted as supernumerary species; the dagger annotation has been retained in the index. It is not apparent why Fries excluded these species from the numbered sequences. A small number of additional species that are both unmarked and unnumbered in *Epicrisis* are indicated in the index by a dagger enclosed in square brackets. For taxa Fries prefixed with a question mark (?), this annotation has been retained in the index.

Pagination Errors

The pagination of *Epicrisis* contains one major ambiguity; the page numbers '79' and '80' are repeated on two consecutive leaves. In this index, the pages of the second leaf are designated as '79[bis]' and '80[bis]'. There are another three trivial errors in page numbering: p. 215 printed as '521'; p. 222 as '122'; and p. 554 as '553'. The entries for names that appear on these pages are annotated accordingly.

Dates and Publications

Although the title page of *Epicrisis* carries the date '1836–1838', the evidence suggests the work was not issued in parts but published complete in late 1838 (Stafleu & Cowan 1976); the date has been accepted as '1838' throughout the index. Names attributed to Paulet have been assigned a tentative date of '?1793',

the probable publication date of his *Traité des Champignons* (Stafleu & Cowan 1983). Persoon's *Observationes Mycologicae, Pars Secunda* has been dated as '1800' rather than the title page date of '1799' (Stafleu & Cowan 1983), and Nees von Esenbeck's *Das System der Pilze und Schwämme* has been dated as '1816–17' to reflect the uncertainty shrouding its original publication (Stafleu & Cowan 1981). I have been unable to establish publication dates for *Agaricus ocreatus* sensu Dunal [see: *dunalii*, *Montagnites*] and *Clavaria kunzei* sensu Krombh. [see: *krombholzii*, *Clavaria*].

Fries referred a number of West African taxa to figures in, variously, '*Fung. Guin.*', '*Fr. Fung. Guin.*', '*Fr. Afz. Guin.*', and '*Fr. Afz. Fung. Guin.*' These are citations of the figures prepared for Fries's manuscript, *Adami Afzelii Fungi Guineenses*. Only the first 8 pages of this manuscript were published (Fries 1837), describing just one monotypic genus, *Stylobates*, and four species of *Lentinus*. The remainder of the text and all of the figures have never been published. The '*Fung. Guin.*' names (except for those published in Fries 1837) are indexed as having been first published in *Epicrisis*, and annotated with Fries's reference to the unpublished manuscript.

Acknowledgements

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Index to *Epicrisis Systematis Mycologici. 1: Agaricini*

Taxon	Page	[Hym. Eur. page]
A		
abietina [sic], Lenzites – See <i>abietinus</i> , <i>Lenzites</i>		
<i>abietinus</i> , <i>Lenzites</i> [(Bull.:Fr.) Fr. 1838, comb. nov., ‘abietina’] . 407		[495 ‘abietina’]
= <i>Agaricus abietinus</i> Bull.:Fr. 1790		
= <i>Daedalea abietina</i> (Bull.:Fr.) Fr. 1821		
<i>absinthiiatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) <i>pachyphyllus</i> var.		
[(Lasch) Fr. 1838, comb. nov.] 80		[107]
= <i>Agaricus absinthiiatus</i> Lasch:Fr. 1828		
<i>abstrusus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1838, sp. nov.] 194		[257]
<i>acerbus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Bull. ex Pers.:Fr. 1801] 49		[71]
<i>acerinus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr. 1838, sp. nov.] 134		[175]
<i>acerosus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr.:Fr. 1821] 135		[178]
<i>acervatus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr.:Fr. 1821] 92		[122]
<i>acicula</i> , <i>Agaricus</i> (<i>Mycena</i>) [Schaeff. 1774] 114		[147]
<i>acris</i> , <i>Lactarius</i> [(Bolton:Fr.) Gray 1821] 342		[428]
= <i>Agaricus acris</i> Bolton:Fr. 1788		
<i>acuminatus</i> , <i>Agaricus</i> (<i>Panaeolus</i>) [Schaeff. 1774] 237		[312]
<i>acutesquamosus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Weinm.:Fr. 1822] 14		[31 as <i>Agaricus</i> <i>friesii</i> * <i>acutesquamosus</i>]
<i>acutus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Pers.:Fr.) Fr. 1838, comb. nov.] 314		[398]
= <i>Agaricus acutus</i> Pers.:Fr. 1801		
<i>adhaerens</i> , <i>Lentinus</i> [(Alb. & Schwein.:Fr.) Fr. 1836] 391		[483]
= <i>Agaricus adhaerens</i> Alb. & Schwein.:Fr. 1805		
<i>adiposus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Batsch:Fr. 1786] 166		[222 ‘non Batsch’]
<i>adonis</i> , <i>Agaricus</i> (<i>Mycena</i>) [Bull.:Fr. 1792–93] 102		[134]
= <i>Mycena adonis</i> (Bull.:Fr.) Gray 1821		
<i>adstringens</i> , <i>Agaricus</i> (<i>Tricholoma</i>) <i>melaleucus</i> var.		
[(Pers.) Fr. 1838, comb. nov.] 51		[74]
= <i>Agaricus adstringens</i> Pers.:Fr. 1801		
<i>adulterina</i> , <i>Russula integra</i> var. [Fr. 1838, var. nov.] 360		[451]
<i>adunatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Secr. ex Fr. 1838, sp. nov.] . . . 66		[92]
= <i>Agaricus adunatus</i> Secr. 1833, nom. inval.		
<i>adusta</i> , <i>Russula</i> [(Pers.:Fr.) Fr. 1838, comb. nov.] 350		[439]
= <i>Agaricus adustus</i> Pers.:Fr. 1801		
<i>aegerita</i> , <i>Agaricus</i> (<i>Pholiota</i>) [V.Brig. 1824] 164		[219]
<i>aeruginosus</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Curtis:Fr. 1786] 218		[284]
<i>aestuans</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1821] 31		[54]
<i>aethiops</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Scop. 1772] 152		[202]
<i>aetites</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr. 1838, sp. nov., ‘aetitis’] 110		[143]
aetitis [sic], <i>Agaricus</i> – See <i>aetites</i> , <i>Agaricus</i>		
<i>affer</i> , <i>Xerotus</i> [Fr.:Fr. 1828] 401		[–]
<i>affricatus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr.:Fr. 1818] 123		[158]

Taxon	Page	[Hym. Eur. page]
<i>Agaricus</i> [L.:Fr. 1753]	2, 596	[2, 17]
<i>agathosmus</i>, <i>Hygrophorus</i> [(Fr.) Fr. 1838, comb. nov.]	325	[411]
= <i>Agaricus agathosmus</i> Fr. 1815		
<i>aggregatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Schaeff. 1774]	65	[90]
<i>albellus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [DC. 1805]	43	[67]
nom. illegit., non <i>Agaricus albellus</i> Scop. 1772		
<i>albertini</i> [sic], <i>Agaricus</i> – See <i>albertinii</i> , <i>Agaricus</i>		
<i>albertinii</i> [' <i>albertini</i> '], <i>Agaricus</i> (<i>Pleurotus</i>) [Fr.:Fr. 1821]	129	[166]
<i>albida</i> [sic], <i>Lenzites</i> – See <i>albidus</i> , <i>Lenzites</i>		
<i>albidus</i> , <i>Cantharellus</i> [Fr.:Fr. 1821]	365	[457]
<i>albidus</i>, <i>Lenzites</i> [(Fr.:Fr.) Fr. 1838, comb. nov., '<i>albida</i>']	405	[493 ' <i>albida</i> ']
= <i>Daedalea albida</i> Fr.:Fr. 1815		
<i>albobrunneus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Pers.:Fr. 1801]	29	[51]
<i>albocyanus</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Desm. 1823]	219	[284]
<i>alboviolaceus</i>, <i>Cortinarius</i> (<i>Inoloma</i>)		
[(Pers.:Fr.) Fr. 1838, comb. nov.]	280	[361]
= <i>Agaricus alboviolaceus</i> Pers.:Fr. 1801		
<i>albus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Schaeff.:Fr. 1774]	47	[70]
<i>alcalinus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1818]	109	[141]
<i>aleuriatus</i> , <i>Agaricus</i> (<i>Galera</i>) [Fr.:Fr. 1815]	203	[266]
<i>algidus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr.:Fr. 1821]	137	[180]
<i>alliaceus</i>, <i>Marasmius</i> [(Jacq.:Fr.) Fr. 1838, comb. nov.]	383	[475]
= <i>Agaricus alliaceus</i> Jacq.:Fr. 1773		
<i>alliodorus</i>, <i>Marasmius</i> [(Mont.) Fr. 1838, comb. nov.]	384	[–]
= <i>Cantharellus alliodorus</i> Mont. 1835		
<i>allutus</i>, ? <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.]	263	[343]
<i>alnicola</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr.:Fr. 1821]	187	[248]
<i>alopecia</i>, <i>Coprinus</i> [Fr. 1838, sp. nov.]	248	[327]
<i>alopecia</i> [' <i>alopecinus</i> '], <i>Lentinus</i> [Fr. 1836]	392	[–]
<i>alopecinus</i> [sic], <i>Lentinus</i> – See <i>alopecia</i> , <i>Lentinus</i>		
<i>alter</i>, <i>Agaricus</i> (<i>Tricholoma</i>) <i>saponaceus</i> var.		
[Fr. 1838, nom. nov.]	36	[–]
= <i>Agaricus myomyces</i> β <i>myomyces-alter</i> Fr.:Fr. 1821		
<i>alternatus</i>, <i>Coprinus</i> [(Schumach.) Fr. 1838, comb. nov.]	248	[327]
= <i>Agaricus alternatus</i> Schumach. 1803		
<i>alumnus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Bolton 1792]	88	[117]
<i>alutacea</i>, <i>Russula</i> [(Pers.) Fr. 1838, comb. nov.]	362	[453]
= <i>Russula esculenta</i> var. β <i>R. alutacea</i> Pers.:Fr. 1796		
= <i>Agaricus Russula alutaceus</i> (Pers.) Pers. 1801		
<i>alutipes</i>, <i>Cortinarius</i> (<i>Myxacium</i>)		
[(Lasch:Fr.) Fr. 1838, comb. nov.]	273	[354]
= <i>Agaricus alutipes</i> Lasch:Fr. 1828		
<i>alveolus</i> , <i>Agaricus</i> (<i>Crepidotus</i>) [Lasch 1829]	210	[275]
<i>amadelphus</i>, <i>Marasmius</i> [(Bull.:Fr.) Fr. 1838, comb. nov.]	380	[474]
= <i>Agaricus amadelphus</i> Bull.:Fr. 1792		

Taxon	Page	[Hym. Eur. page]
<i>Amanita</i> , <i>Agaricus</i> trib. [(Pers.:Fr.) Fr. 1821]	3, 596	[2, 17]
= <i>Amanita</i> Pers.:Fr. 1797		
<i>amarella</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Pers. 1828]	.60	[84]
<i>amarus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [(Alb. & Schwein.) Fr. 1821]	.60	[83]
= <i>Agaricus rivulosus</i> β <i>amarus</i> Alb. & Schwein.:Fr. 1805		
<i>ambustus</i> , <i>Agaricus</i> (<i>Collybia</i>) [(Fr.:Fr.) Fr. 1821]	.97	[127]
= <i>Agaricus umbratilis</i> β <i>A. ambustus</i> Fr.:Fr. 1821		
[The taxon was raised to specific rank (somewhat ambiguously) in Fries 1821, p. 507, with an incorrectly cited page reference; the species was not listed in Fries 1832.]		
<i>amethystinus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Scop.1772]	.44	[68]
<i>amianthinus</i> , <i>Agaricus</i> (<i>Lepiota</i>) <i>granulosus</i> var.		
[(Scop.) Fr. 1838, comb. nov.]	18	[37 as <i>Agaricus amianthinus</i>]
= <i>Agaricus amianthinus</i> Scop. 1772		
<i>amictus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1821]	.112	[144]
<i>ammoniacus</i> , <i>Agaricus</i> (<i>Mycena</i>) [(Fr.) Fr. 1838, comb. nov.]	.109	[142]
= <i>Agaricus alcalinus</i> γ <i>ammoniacus</i> Fr. 1818		
<i>amoenus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Weinm.:Fr. 1828]	.197	[260]
<i>amplus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Pers.:Fr. 1801]	.64	[89]
<i>amsegetes</i> , <i>Agaricus</i> (<i>Mycena</i>) <i>vitis</i> var. [Fr. 1838, var. nov.]	.113	[146]
<i>amurceus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.]	.273	[353]
<i>anatinus</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Lasch:Fr. 1829]	.152	[201]
<i>androsaceus</i> , <i>Marasmius</i> [(L.:Fr.) Fr. 1838, comb. nov.]	.385	[477]
= <i>Agaricus androsaceus</i> L.:Fr. 1753		
<i>anfractus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.]	.262	[341]
<i>angineus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1838, sp. nov.]	.193	[255]
<i>angulosus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.]	.308	[392]
<i>angustissimus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Lasch:Fr. 1829]	.78	[105]
<i>angustus</i> , <i>Agaricus</i> (<i>Clitopilus</i>) [Pers.:Fr. 1801]	.150	[200]
<i>anomalus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	.286	[369]
= <i>Agaricus anomalus</i> Fr.:Fr. 1818		
<i>anthracinus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>) <i>sanguineus</i> var.		
[Fr. 1838, var. nov.]	.288	[370 as <i>Cortinarius anthracinus</i>]
<i>antillarum</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Fr.:Fr. 1828]	.225	[-]
<i>antipus</i> , <i>Agaricus</i> (<i>Galera</i>) [Lasch:Fr. 1828]	.205	[268]
<i>apalus</i> , <i>Agaricus</i> (<i>Galera</i>) [Fr.:Fr. 1818]	.204	[267]
<i>aphthosus</i> , <i>Coprinus</i> [Fr. 1838, sp. nov.]	.245	[323]
<i>apicreus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr. 1838, sp. nov.]	.188	[249]
<i>apiculatus</i> , <i>Agaricus</i> (<i>Eccilia</i>) [Fr. 1838, sp. nov.]	.159	[211]
<i>appendiculatus</i> , <i>Agaricus</i> (<i>Hypholoma</i>) [Bull. 1789]	.224	[296]
<i>applanata</i> [sic], <i>Lenzites</i> – See <i>applanatus</i> , <i>Lenzites</i>		
<i>applanatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) <i>orbiformis</i> var.		
[Fr. 1838, var. nov.]	.77	[103]
= <i>Agaricus applanatus</i> Secr. 1833, nom. inval. et illegit., non Pers. 1796		
<i>applanatus</i> , <i>Agaricus</i> (<i>Crepidotus</i>) [Pers. 1796]	.210	[275]

Taxon	Page	[Hym. Eur. page]
<i>applanatus</i>, <i>Lenzites</i>		
[(Klotzsch) Fr. 1838, comb. nov., ‘ <i>applanata</i> ’]	404	[–]
= <i>Daedalea applanata</i> Klotzsch 1833		
<i>applicatus</i>, <i>Agaricus</i> (<i>Pleurotus</i>) [Batsch:Fr. 1783]	137	[180]
<i>aquatilis</i>, <i>Agaricus</i> (<i>Galera</i>) [(Fr.) Fr. 1838, comb. nov.]	208	[270]
= <i>Agaricus hypnorum</i> δ <i>A. aquatilis</i> Fr.:Fr. 1821		
<i>aquifolii</i>, <i>Agaricus</i> (<i>Pleurotus</i>) [(Paulet) Fr. 1838, comb. nov.]	132	[171]
= <i>Hypophyllum aquifolii</i> Paulet ?1793		
<i>aquilus</i>, <i>Agaricus</i> (<i>Leptonia</i>) [Fr.:Fr. 1821]	154	[204]
<i>aquosus</i>, <i>Agaricus</i> (<i>Collybia</i>) [Bull.:Fr. 1780–81]	93	[122]
<i>arbustivus</i>, <i>Hygrophorus</i> [Fr. 1836]	323	[408]
<i>archyropus</i>, <i>Marasmius</i> [(Pers.) Fr. 1838, comb. nov.]	378	[471]
= <i>Agaricus archyropus</i> Pers. 1828		
<i>arcuatus</i>, <i>Agaricus</i> (<i>Tricholoma</i>) [Bull.:Fr. 1790]	46	[70]
<i>ardosiaceus</i> [‘ <i>ardosiacus</i> ’], <i>Agaricus</i> (<i>Entoloma</i>)		
[Bull.:Fr. 1788]	145	[191 ‘ <i>ardosiacus</i> ’]
<i>ardosiacus</i> [sic], <i>Agaricus</i> – See <i>ardosiaceus</i> , <i>Agaricus</i>		
<i>arecarius</i>, <i>Marasmius</i> [(Lour.:Fr.) Fr. 1838, comb. nov.]	380	[–]
= <i>Agaricus arecarius</i> Lour.:Fr. 1790		
<i>arenatus</i>, <i>Cortinarius</i> (<i>Inoloma</i>) [(Pers.) Fr. 1838, comb. nov.]	283	[365]
= <i>Agaricus arenatus</i> Pers. 1801		
<i>argematus</i>, <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	340	[427]
= <i>Agaricus argematus</i> Fr.:Fr. 1818		
<i>argentatus</i>, <i>Cortinarius</i> (<i>Inoloma</i>)		
[(Pers.:Fr.) Fr. 1838, comb. nov.]	278	[360]
= <i>Agaricus argentatus</i> Pers.:Fr. 1801		
<i>argutus</i>, <i>Cortinarius</i> (<i>Inoloma</i>) [Fr. 1838, sp. nov.]	278	[359]
<i>argyraceus</i>, <i>Agaricus</i> (<i>Tricholoma</i>) <i>terreus</i> var.		
[(Bull.) Fr. 1838, comb. nov.]	35	[58]
= <i>Agaricus argyraceus</i> Bull. 1789		
<i>aridus</i>, <i>Agaricus</i> (<i>Amanita</i>) [Fr. 1838, sp. nov.]	10	[25]
nom. illegit., non <i>Agaricus aridus</i> Pers. 1828, nec Lasch 1829		
<i>armeniacus</i>, <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Schaeff.:Fr.) Fr. 1838, comb. nov.]	304	[387]
= <i>Agaricus armeniacus</i> Schaeff.:Fr. 1774		
<i>Armillaria</i>, <i>Agaricus</i> trib. [Fr.:Fr. 1821]	20, 596	[2, 40]
<i>armillatus</i>, <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	295	[378]
= <i>Agaricus armillatus</i> Fr.:Fr. 1818		
<i>arquatus</i>, <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.] . .	265	[346]
<i>arrhenii</i>, <i>Agaricus</i> (<i>Pholiota</i>) [Fr. 1838, sp. nov.]	161	[216 sub <i>Agaricus togularis</i>]
<i>arvalis</i>, <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1821]	197	[261]
<i>arvensis</i>, <i>Agaricus</i> (<i>Psalliota</i>) [Schaeff. 1774]	213	[278]
<i>arvinaceus</i>, <i>Cortinarius</i> (<i>Myxacium</i>) [Fr. 1838, sp. nov.] . .	274	[354]

Taxon	Page	[Hym. Eur. page]
<i>asemus</i> , <i>Agaricus</i> (<i>Collybia</i>) [(Fr.:Fr.) Fr. 1821]	85	[114]
= <i>Agaricus butyraceus</i> γ <i>asemus</i> Fr. 1818		
<i>asper</i> , <i>Agaricus</i> (<i>Amanita</i>) [Pers.:Fr. 1793]	9	[24]
= <i>Amanita aspera</i> (Pers.Fr.) Pers. 1800		
<i>asper</i> , <i>Lenzites</i> [(Klotzsch) Fr. 1838, comb. nov., 'aspera']	405	[-]
= <i>Daedalea aspera</i> Klotzsch 1833		
<i>aspera</i> [sic], <i>Lenzites</i> – See <i>asper</i> , <i>Lenzites</i>		
<i>aspideus</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	336	[424]
= <i>Agaricus aspideus</i> Fr.:Fr. 1818		
<i>asprellus</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Fr.:Fr. 1821]	154	[205]
<i>asterophora</i> , <i>Nyctalis</i> [Fr. 1838, nom. nov.]	371	[463, 705]
= <i>Agaricus lycoperdoides</i> Bull. 1783–84, nom. cons., non Sowerby:Fr. 1800–03		
= <i>Asterophora lycoperdoides</i> (Bull.) Ditmar 1809, nom. cons., non (Sowerby:Fr.) Fr. 1817		
= <i>Asterophora agaricoides</i> Fr.:Fr. 1817		
<i>astragalinus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr.:Fr. 1821]	186	[248]
<i>astroideus</i> , <i>Coprinus niveus</i> var. [(Fr.) Fr. 1838, comb. nov.] .	247	[325 as <i>Coprinus astroideus</i>]
= <i>Agaricus Coprinus astroideus</i> Fr.:Fr. 1821		
<i>atomatus</i> , <i>Agaricus</i> (<i>Psathyrella</i>) [Fr.:Fr. 1821]	239	[315]
<i>atramentarius</i> , <i>Coprinus</i> [(Bull.:Fr.) Fr. 1838, comb. nov.] . .	243	[322]
= <i>Agaricus atramentarius</i> Bull.:Fr. 1783–84		
<i>atratus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr.:Fr. 1818]	98	[127]
<i>atrides</i> , <i>Agaricus</i> (<i>Eccilia</i>) [Lasch:Fr. 1829]	159	[212]
<i>atroalbus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Bolton:Fr. 1790]	108	[140]
= <i>Mycena atroalba</i> (Bolton:Fr.) Gray 1821		
<i>atrobrunneus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Lasch:Fr. 1828]	227	[297]
<i>atrocaeruleus</i> ['atrocoeruleus'], <i>Agaricus</i> (<i>Pleurotus</i>)		
[Fr.:Fr. 1815]	137	[179]
<i>atrocinereus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Pers. 1801]	37	[60]
<i>atrocoeruleus</i> [sic], <i>Agaricus</i> – See <i>atrocaeruleus</i> , <i>Agaricus</i>		
<i>atrocyaneus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Batsch:Fr. 1786]	109	[141]
<i>atromarginatus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Lasch:Fr. 1828]	101	[132]
<i>atropunctus</i> , <i>Agaricus</i> (<i>Eccilia</i>) [Pers.:Fr. 1801]	159	[212]
<i>atrorufus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Schaeff.:Fr. 1774]	230	[300]
<i>atrotomentosus</i> , <i>Paxillus</i> [(Batsch:Fr.) Fr. 1838, comb. nov.] .	317	[403]
= <i>Agaricus atrotomentosus</i> Batsch:Fr. 1783		
<i>attenuatus</i> , <i>Agaricus</i> (<i>Pholiota</i>) <i>cylindraceus</i> var.		
[(DC.) Fr. 1838, comb. nov.]	164	[218 sub <i>Agaricus cylindraceus</i>]
= <i>Agaricus attenuatus</i> DC.:Fr. 1815		
<i>aueri</i> , ? <i>Agaricus</i> (<i>Collybia</i>) [Nees & T.Nees:Fr. 1818]	90	[317]
<i>augustus</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Fr. 1838, sp. nov.]	212	[278]
<i>aurantiacus</i> , <i>Cantharellus</i> [(Wulfen:Fr.) Fr. 1821]	365	[455]
= <i>Agaricus aurantiacus</i> Wulfen:Fr. 1781		
<i>aurantiacus</i> , <i>Lactarius</i> [(Pers.:Fr.) Gray 1821]	343	[432]
= <i>Agaricus Lactifluus testaceus</i> γ <i>L. aurantiacus</i> Pers. 1801		
= <i>Agaricus aurantiacus</i> (Pers.:Fr.) Fr. 1821, non Wulfen:Fr. 1781		

Taxon	Page	[Hym. Eur. page]
<i>aurantiomarginatus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1821]	100	[131]
<i>aurantius</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Schaeff.:Fr. 1774]	21	[41]
<i>aurata</i> , <i>Russula</i> [Fr. 1838, nom. nov.]	360	[452]
= <i>Agaricus auratus</i> With. 1792, nom. illegit., non O.F.Müll. 1782		
<i>auratus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	28	[50]
nom. illegit., non <i>Agaricus auratus</i> O.F.Müll. 1782, nec With. 1792		
<i>aureus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Matt.:Fr. 1779]	160	[214]
<i>auricomus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) <i>descissus</i> var.		
[(Batsch) Fr. 1838, comb. nov.]	175	[233]
= <i>Agaricus auricomus</i> Batsch 1783		
<i>auricula</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [(Dubois:Fr.) DC. 1815]	57	[81]
= <i>Amanita auricula</i> Dubois:Fr. 1803		
<i>auriscalpium</i> , <i>Cantharellus</i> [Fr.:Fr. 1828]	368	[462 as <i>Arrhenia auriscalpium</i>]
<i>aurivellus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Batsch:Fr. 1786]	165	[220]
<i>auroreus</i> , <i>Agaricus</i> (<i>Collybia</i>) <i>butyraceus</i> var.		
[Fr. 1838, var. nov.]	84	[113]
<i>austerus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr. 1838, sp. nov.]	188	[249]
<i>avenaceus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1821]	101	[132]
<i>azonites</i> , <i>Lactarius</i> [(Bull.) Fr. 1838, comb. nov.]	343	[428 sub <i>Lactarius</i>
= <i>Agaricus azonites</i> Bull. 1792–93		<i>squalidus</i> ; 434 sub <i>Lactarius fuliginosus</i>]
<i>azureus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>) [Fr. 1838, sp. nov.]	286	[368]
<i>azymus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr. 1838, sp. nov.]	188	[250]

B

<i>baccatus</i> , <i>Agaricus</i> (<i>Amanita</i>) [Fr. 1838, sp. nov.]	12	[28]
<i>badipes</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1838, sp. nov.]	196	[259]
<i>balaninus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Berk. 1837]	99	[130]
<i>balaustinus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.]	307	[391]
<i>balteatus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Fr.) Fr. 1838, comb. nov.]	257	[337]
= <i>Agaricus balteatus</i> Fr. 1818		
<i>bambusinus</i> , <i>Marasmius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	385	[–]
= <i>Agaricus bambusinus</i> Fr.:Fr. 1830		
<i>batschianus</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Fr. 1836]	144	[191]
<i>battarrae</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Fr.:Fr. 1821]	217	[289]
<i>bellus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Pers.:Fr. 1801]	79[bis]	[107]
<i>benzonii</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1828]	104	[136]
<i>berlangeri</i> , <i>Trogia</i> [(Mont.) Fr. 1838, comb. nov.]	402	[–]
= <i>Agaricus berlangeri</i> Mont. 1834		
<i>bertieri</i> [sic], <i>Lentinus</i> – See <i>berteroi</i> , <i>Lentinus</i>		
<i>bertierii</i> [sic], <i>Xerotus</i> – See <i>berteroi</i> , <i>Xerotus</i>		
<i>berteroi</i> ['bertieri'], <i>Lentinus</i> [(Fr.:Fr.) Fr. 1825]	388	[–]
= <i>Agaricus berteroi</i> Fr.:Fr. 1821		

Taxon	Page	[Hym. Eur. page]
<i>berteroii</i> ['bertierii'], <i>Xerotus</i> [Mont. 1835]	402	[-]
<i>betulina</i> [sic], <i>Lenzites</i> – See <i>betulinus</i> , <i>Lenzites</i>		
<i>betulinus</i>, <i>Lenzites</i> [(L.:Fr.) Fr. 1838, comb. nov., 'betulina'] . . .	405	[493 'betulina']
= <i>Agaricus betulinus</i> L.:Fr. 1753		
<i>biformis</i>, <i>Cortinarius</i> (<i>Telamonia</i>) [Fr. 1838, sp. nov.]	299	[383]
<i>bifurcatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Weinm. 1836]	60	[85]
<i>birrus</i>, <i>Agaricus</i> (<i>Hebeloma</i>) [Fr. 1838, sp. nov.]	179	[239]
<i>bivelus</i>, <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	292	[375]
= <i>Agaricus bivelus</i> Fr.:Fr. 1818		
<i>blattarius</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr.:Fr. 1821]	162	[216]
<i>blennius</i>, <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	337	[425]
= <i>Agaricus blennius</i> Fr.:Fr. 1815		
<i>bolaris</i>, <i>Cortinarius</i> (<i>Inoloma</i>)		
[(Pers.:Fr.) Fr. 1838, comb. nov.]	282	[364]
= <i>Agaricus bolaris</i> Pers.:Fr. 1801		
<i>Bolbitius</i> [Fr. 1838, gen. nov.]	253, 600	[7, 333]
<i>boltonii</i>, <i>Bolbitius</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	254	[333]
= <i>Agaricus boltonii</i> Pers.:Fr. 1801		
<i>bombycinus</i> , <i>Agaricus</i> (<i>Volvaria</i>) [Schaeff.:Fr. 1774]	138	[182]
= <i>Pluteus bombycinus</i> (Schaeff.:Fr.) Fr. 1836		
<i>bongardii</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Weinm. 1836]	173	[229]
<i>borealis</i>, <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	44	[67]
<i>bovinus</i>, <i>Cortinarius</i> (<i>Telamonia</i>) [Fr. 1838, sp. nov.]	297	[381]
<i>brachypodes</i> , <i>Cantharellus</i> [Chevall.:Fr. 1826]	365	[456]
<i>brasiliensis</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr.:Fr. 1830]	190	[-]
<i>brevipes</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Bull. 1791]	51	[75]
<i>brumalis</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1818]	76	[103]
<i>brunneofulvus</i>, <i>Cortinarius</i> (<i>Telamonia</i>)		
[Fr. 1838, sp. nov.]	298	[381]
<i>brunneus</i>, <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Pers.:Fr.) Fr. 1838, comb. nov.]	298	[381]
= <i>Agaricus brunneus</i> Pers.:Fr. 1801		
<i>bryophilus</i> , <i>Cantharellus</i> [(Pers.:Fr.) Fr. 1821]	368	[460]
= <i>Agaricus bryophilus</i> Pers.:Fr. 1796		
<i>bryorum</i> , <i>Agaricus</i> (<i>Galera</i>) <i>hypnorum</i> var. [Fr.:Fr. 1821]	207	[270]
= <i>Agaricus hypnorum</i> β <i>A. bryophilus</i> Pers. 1801		
<i>bufonius</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Pers.:Fr. 1801]	40	[63]
<i>bulbiger</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Alb. & Schwein.:Fr. 1805]	20	[40]
<i>bulbopilis</i> , $\dagger$ <i>Agaricus</i> (<i>Collybia</i>) [Raddi 1806]	86	[317]
<i>bulbosus</i>, <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Sowerby:Fr.) Fr. 1838, comb. nov.]	292	[375]
= <i>Agaricus bulbosus</i> Sowerby:Fr. 1798–99, non Schaeff. 1774		
<i>bullaceus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Bull.:Fr. 1792–93]	229	[299]
<i>bulliardi</i> [sic], <i>Cortinarius</i> – See <i>bulliardii</i> , <i>Cortinarius</i>		

Taxon	Page	[Hym. Eur. page]
<i>bulliardii</i>, <i>Cortinarius</i> (<i>Inoloma</i>)		
[(Pers.:Fr.) Fr. 1838, comb. nov., 'bulliardii']	282	[363 'bulliardii']
= <i>Agaricus bulliardii</i> Pers.:Fr. 1800		
<i>butyraceus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Bull.:Fr. 1792]	84	[113]
<i>buxbaumii</i> , <i>Agaricus</i> (<i>Hypholoma</i>) [Weinm. 1832]	223	[292]
<i>byssisedus</i> , <i>Agaricus</i> (<i>Crepidotus</i>) [Pers.:Fr. 1800]	212	[214]
C		
<i>cacabus</i>, <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1838, nom. nov.]	72	[98]
= <i>Agaricus gibbus</i> $\beta\beta$ <i>fuligineus</i> Alb. & Schwein.:Fr. 1805		
<i>caelatus</i>, <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	42	[66]
<i>caelestinus</i>, <i>Agaricus</i> (<i>Nolanea</i>) [Fr. 1838, sp. nov., 'coelestinus'] .	158	[210 'coelestinus']
<i>caerulea</i>, <i>Russula</i> [Fr. 1838, nom. nov., 'coerulea']	353	[443]
= <i>Agaricus Russula caeruleus</i> Pers. 1801, nom. illegit., non <i>Agaricus caeruleus</i> Bolton 1788		
<i>caerulescens</i>, <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Schaeff.) Fr. 1838, comb. nov., 'caerulescens']	265	[345]
= <i>Agaricus caerulescens</i> Schaeff. 1774		
<i>caesareus</i>, <i>Agaricus</i> (<i>Amanita</i>) [Scop.:Fr. 1772]	3	[17]
= <i>Amanita caesarea</i> (Scop.:Fr.) Pers. 1801		
<i>caesariatus</i>, <i>Agaricus</i> (<i>Hebeloma</i>) [Fr. 1838, sp. nov.]	176	[234]
<i>caesariatus</i>, <i>Agaricus</i> (<i>Tricholoma</i>) <i>albus</i> var.		
[Fr. 1838, var. nov.]	47	[71]
<i>calamistratus</i>, <i>Agaricus</i> (<i>Hebeloma</i>) [Fr.:Fr. 1821]	171	[227]
<i>calathus</i>, <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1838, sp. nov.]	75	[101]
<i>calceatus</i>, <i>Agaricus</i> (<i>Psalliota</i>) [Fr. 1838, sp. nov.]	216	[287]
<i>calceolus</i>, <i>Agaricus</i> (<i>Tricholoma</i>) <i>panaeolus</i> var.		
[Fr. 1838, var. nov.]	49	[73]
<i>caliginosus</i>, <i>Agaricus</i> (<i>Panaeolus</i>) [Jungh.:Fr. 1830]	236	[312]
<i>calimorphus</i>, <i>Agaricus</i> (<i>Leptonia</i>) [Weinm. 1832]	153	[204]
<i>callisteus</i>, <i>Cortinarius</i> (<i>Inoloma</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	281	[363]
= <i>Agaricus callisteus</i> Fr.:Fr. 1818		
<i>callochrous</i> [sic], <i>Cortinarius</i> – See <i>calochrous</i>, <i>Cortinarius</i>		
<i>callosus</i>, <i>Agaricus</i> (<i>Psilocybe</i>) [Fr.:Fr. 1818]	230	[301]
<i>calochrous</i>, <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Pers.:Fr.) Fr. 1838, comb. nov., 'callochrous']	265	[345]
= <i>Agaricus calochrous</i> Pers.:Fr. 1801		
<i>calophyllus</i>, <i>Agaricus</i> (<i>Eccilia</i>) [Pers.:Fr. 1801]	160	[212]
<i>calopus</i>, <i>Marasmius</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	379	[472]
= <i>Agaricus calopus</i> Pers.:Fr. 1801		
<i>camerinus</i>, <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1838, sp. nov.]	196	[259]
<i>campanella</i>, <i>Agaricus</i> (<i>Omphalia</i>) [Batsch:Fr. 1783]	126	[162]
<i>campanulatus</i>, <i>Agaricus</i> (<i>Galera</i>) [Bull.:Fr. 1792]	205	[268 sub <i>Agaricus</i>
non <i>Agaricus campanulatus</i> L. 1753		<i>ovalis</i>]
<i>campanulatus</i>, <i>Agaricus</i> (<i>Panaeolus</i>) [L. 1753]	236	[311]
non <i>Agaricus campanulatus</i> Bull.:Fr. 1792		

Taxon	Page	[Hym. Eur. page]
<i>campestris</i> , <i>Agaricus</i> (<i>Psalliota</i>) [L.:Fr. 1753]	213	[279]
= <i>Pluteus campestris</i> (L.:Fr.) Fr. 1836		
<i>camphoratus</i>, <i>Cortinarius</i> (<i>Inoloma</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	280	[362]
= <i>Agaricus camphoratus</i> Fr.:Fr. 1821		
<i>camphoratus</i>, <i>Lactarius</i> [(Bull.) Fr. 1838, comb. nov.]	346	[437]
= <i>Agaricus camphoratus</i> Bull. 1792-93, non Fr.:Fr. 1821		
= <i>Agaricus subdulcis</i> β <i>camphoratus</i> (Bull.:Fr.) Fr. 1821		
campylus [sic], <i>Lactarius</i> – See <i>crampylus</i> , <i>Lactarius</i>		
<i>camurus</i>, <i>Cortinarius</i> (<i>Dermocybe</i>) [Fr. 1838, sp. nov.]	285	[367]
<i>canaliculata</i>, <i>Nyctalis</i> [(Pers.) Fr. 1838, comb. nov.]	371	[463]
= <i>Merulius canaliculatus</i> Pers. 1800		
<i>cancrinus</i>, <i>Agaricus</i> (<i>Clitopilus</i>) [Fr. 1838, sp. nov.]	150	[199]
nom. illegit., non <i>Agaricus cancrinus</i> G.Mey.:Fr. 1818		
<i>cancrinus</i> [' <i>canerinus</i> '], <i>Agaricus</i> (<i>Galera</i>) [G.Mey.:Fr. 1818]	204	[-]
<i>candelaris</i>, <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.]	305	[388]
<i>candicans</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Pers.:Fr. 1801]	63	[88]
<i>candidus</i>, <i>Marasmius</i> [Fr. 1838, sp. nov.]	381	[474]
= <i>Agaricus candidus</i> sensu Bolton 1788, non Schaeff. 1774, nec Huds. 1778, nec Batsch 1786		
<i>candolleanus</i> [' <i>candollianus</i> '], <i>Agaricus</i> (<i>Hypholoma</i>)		
[Fr.:Fr. 1818]	224	[295]
<i>candollei</i>, <i>Montagnites</i> [Fr. 1838, nom. nov.]	241	[319]
= <i>Agaricus arenarius</i> DC. 1815		
candollianus [sic], <i>Agaricus</i> – See <i>candolleanus</i> , <i>Agaricus</i>		
canerinus [sic], <i>Agaricus</i> (<i>Galera</i>) – See <i>cancrinus</i> , <i>Agaricus</i> (<i>Galera</i>)		
<i>canescens</i> , <i>Agaricus</i> (<i>Mycena</i>) [Weinm. 1836]	114	[146]
<i>caninus</i>, <i>Cortinarius</i> (<i>Dermocybe</i>) [(Fr.) Fr. 1838, comb. nov.]	285	[368]
= <i>Agaricus anomalus</i> ϵ <i>caninus</i> Fr.:Fr. 1821		
= <i>Agaricus caninus</i> (Fr.) Weinm. 1836		
<i>canobrunneus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Batsch:Fr. 1786]	225	[302]
<i>Cantharellus</i> [Fr.:Fr. 1821]	364, 602	[9, 455]
<i>cantharellus</i>, <i>Hygrophorus</i>		
[(Schwein.:Fr.) Fr. 1838, comb. nov.]	329	[-]
= <i>Agaricus cantharellus</i> Schwein.:Fr. 1822		
<i>caperatus</i>, <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Pers.:Fr.) Fr. 1838, comb. nov.]	256	[215 as <i>Agaricus</i> <i>caperatus</i>]
= <i>Agaricus caperatus</i> Pers.:Fr. 1796		
<i>capillaris</i> , <i>Agaricus</i> (<i>Mycena</i>) [Schumach.:Fr. 1803]	119	[153]
<i>capniocephalus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Bull. ex DC. 1805]	182	[242]
<i>capnoides</i> , <i>Agaricus</i> (<i>Hypholoma</i>) [Fr.:Fr. 1818]	221	[291]
<i>caprinus</i>, <i>Hygrophorus</i> [(Scop.) Fr. 1838, comb. nov.]	326	[412]
= <i>Agaricus caprinus</i> Scop. 1772		
<i>capronatus</i>, <i>Lentinus</i> [Fr. 1838, sp. nov.]	388	[-]
<i>capsicoides</i>, <i>Lactarius</i> [Fr. 1838, sp. nov.]	339	[429]
<i>caput-medusae</i>, <i>Agaricus</i> (<i>Psalliota</i>) [Fr. 1838, sp. nov.]	216	[288]

Taxon	Page	[Hym. Eur. page]
<i>carbonarius</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr.:Fr. 1818]	186	[247]
<i>carcharias</i> , <i>Agaricus</i> (<i>Lepiota</i>) <i>granulosus</i> var. [(Pers.) Fr. 1838, comb. nov.]	18	[36 as <i>Agaricus</i> <i>carcharius</i>]
= <i>Agaricus carcharias</i> Pers. 1794		
<i>cardarella</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1821]	57	[80]
<i>caribaeus</i> , <i>Xerotus</i> [Fr. 1838, sp. nov.]	401	[-]
<i>cariosus</i> , <i>Agaricus</i> (<i>Amanita</i>) <i>excelsus</i> var. [Fr. 1838, var. nov.] . 8		[24 as <i>Agaricus</i> <i>cariosus</i>]
<i>carneoalbus</i> , <i>Agaricus</i> (<i>Clitopilus</i>) [With. 1796]	150	[200]
<i>carneovirens</i> , <i>Agaricus</i> (<i>Nolanea</i>) [Jungh.:Fr. 1830]	157	[208]
<i>carneus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Bull.:Fr. 1792]	42	[65]
<i>carpini</i> , <i>Agaricus</i> (<i>Crepidotus</i>) [(Paulet) Fr. 1838, comb. nov.] 210		[170 as <i>Agaricus</i> <i>olearius</i> * <i>carpini</i>]
= <i>Dendrosarcus carpini</i> Paulet ?1793		
<i>carpophilus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1815]	202	[265]
<i>carptus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Scop. 1772]	173	[230]
<i>cartilagineus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Bull. ex Pers.:Fr. 1801] . . 36		[60]
<i>cascus</i> , <i>Agaricus</i> (<i>Hypholoma</i>) [Fr. 1838, nom. nov.]	224	[294]
= <i>Agaricus Coprinus macropus</i> Pers. 1801, p. 402, non <i>Agaricus macropus</i> Fr.:Fr. 1821, nec Pers. 1801, p. 275		
<i>castaneus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [(Bull.:Fr.) Fr. 1838, comb. nov.]	307	[391]
= <i>Agaricus castaneus</i> Bull.:Fr. 1786		
<i>castoreus</i> , <i>Lentinus</i> [Fr. 1838, sp. nov.]	395	[486]
<i>catinus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1838, sp. nov.]	72	[99]
<i>caudatus</i> , <i>Agaricus</i> (<i>Psathyrella</i>) [Fr. 1818]	239	[314]
<i>caulicinalis</i> , <i>Marasmius</i> [Fr. 1838, sp. nov., ‘cauticinalis’] 383		[476 ‘cauticinalis’]
= <i>Agaricus caulicinalis</i> sensu Sowerby 1798–99, non Bull. 1791		
[The etymology and original orthography of Bulliard’s (and Sowerby’s) epithet is ‘caulicinalis’. This orthography was retained by Fries (1821) when he sanctioned Bulliard’s name at varietal rank (p. 138) and made reference to Sowerby’s taxon (p. 167); and also retained for both taxa in Index Alphabeticus (Fries 1832, pp. 11–12). In Epicrisis (p. 87) Fries continued to retain the original orthography for Bulliard’s taxon, but introduced the orthography ‘cauticinalis’ (without explanation) for Sowerby’s taxon. In Hym. Eur. (pp. 117, 476, 711) Fries used the variant orthography for both Bulliard’s and Sowerby’s taxa; which suggests that the variant was a persistent (and proliferating!) lapsus calami, rather than an attempt to differentiate the epithets of the two taxa.]		
[Fries’s (1838, 1874) reference to ‘With.’ is erroneous; Withering did not list <i>A. caulicinalis</i> in any of his publications. Fries’s citation (1838, p. 383) of ‘Sow. t. 164’ [i.e. <i>Agaricus pilosus</i>] is a lapsus calami, later corrected to ‘Sow. t. 163’ (Fries 1874, p. 476). Elsewhere (Fries 1838, p. 386) he cited ‘Sowerb. t 164’ correctly as a synonym of <i>Marasmius hudsonii</i> (cf. Fries 1821, p. 139).]		
<i>causticus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.] . . 270		[350]
cauticinalis [sic], <i>Marasmius</i> – See <i>caulicinalis</i> , <i>Marasmius</i>		
<i>centrifugus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [(Fr.:Fr.) Fr. 1838, comb. nov.]	259	[339]
= <i>Agaricus centrifugus</i> Fr.:Fr. 1821		

Taxon	Page	[Hym. Eur. page]
<i>centunculus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1821]	193	[255]
<i>cepaceus</i> , <i>Marasmius</i> [(Fr.:Fr.) Fr. 1836]	375	[467]
= <i>Agaricus cepaceus</i> Fr.:Fr. 1815		
<i>cephalixus</i>, <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[Secr. ex Fr. 1838, sp. nov.]	261	[341]
= <i>Agaricus cephalixus</i> Secr. 1833, nom. inval.		
<i>cepaestipes</i> [sic], <i>Agaricus</i> – See <i>cepistipes</i> , <i>Agaricus</i>		
<i>cepistipes</i> [' <i>cepaestipes</i> '], <i>Agaricus</i> (<i>Lepiota</i>)		
[Sowerby:Fr. 1796–97]	17, (216)	[35 ' <i>cepaestipes</i> ']
<i>ceraceus</i> , <i>Hygrophorus</i> [(Wulfen:Fr.) Fr. 1836]	330	[417]
= <i>Agaricus ceraceus</i> Wulfen:Fr. 1781		
<i>cerinus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Pers.:Fr. 1794]	41	[64]
<i>cernuus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Vahl:Fr. 1790]	226	[302]
<i>cerodes</i>, <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1838, sp. nov.]	195	[257]
<i>cerussatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1821]	61	[86]
<i>cervinus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Hoffm.:Fr. 1789]	71	[97]
non <i>Agaricus cervinus</i> Schaeff. 1774		
<i>cervinus</i> , <i>Agaricus</i> (<i>Pluteus</i>) [Schaeff. 1774]	140	[185]
unavailable name, non <i>Agaricus cervinus</i> Hoffm.:Fr. 1789		
<i>cetratus</i> , <i>Agaricus</i> (<i>Nolanea</i>) [Fr.:Fr. 1818]	157	[208]
<i>chalybaeus</i> [sic], <i>Agaricus</i> – See <i>chalybeus</i> , <i>Agaricus</i>		
<i>chalybeus</i> [' <i>chalybaeus</i> '], <i>Agaricus</i> (<i>Leptonia</i>)		
[Pers.:Fr. 1801]	153	[203 ' <i>chalybaeus</i> ']
<i>chama</i> , <i>Lentinus</i> [(Bosc:Fr.) Fr. 1828]	394	[–]
= <i>Agaricus chama</i> Bosc.:Fr. 1811		
<i>chamaeleontina</i>, <i>Russula</i> [Fr. 1838, nom. nov.]	363	[455]
= <i>Agaricus Russula ochraceus</i> Pers. 1801, nom. illegit.,		
non <i>Agaricus ochraceus</i> Schaeff. 1774		
<i>chelidonium</i>, <i>Agaricus</i> (<i>Mycena</i>) [Fr. 1838, sp. nov.]	115	[148]
= <i>Agaricus pumilus</i> sensu Sowerby 1800–03, non Bull. 1786, nec Pers.:Fr. 1801		
<i>chloranthus</i> [' <i>chlorantus</i> '], <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1818]	102	[134]
<i>chlorantus</i> [sic], <i>Agaricus</i> – See <i>chloranthus</i> , <i>Agaricus</i>		
<i>chlorophanus</i>, <i>Hygrophorus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	332	[420]
= <i>Agaricus chlorophanus</i> Fr.:Fr. 1821		
<i>chordalis</i>, <i>Marasmius</i> [Fr. 1838, sp. nov.]	383	[475]
<i>christinae</i>, <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1838, sp. nov.]	192	[254]
<i>chrysenterus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Bull. ex Pers.:Fr. 1801]	41	[64]
<i>chrysites</i>, <i>Agaricus</i> (<i>Tricholoma</i>) <i>terreus</i> var. [Fr. 1838, sp. nov.]	35	[58]
= <i>Agaricus friesii</i> (var. 3) Jungh. 1830, nom. illegit., non <i>Agaricus friesii</i> Lasch 1828		
<i>chrysodon</i>, <i>Hygrophorus</i>		
[(Batsch:Fr.) Fr. 1838, comb. nov., ' <i>crysodon</i> ']	320	[405]
= <i>Agaricus chrysodon</i> Batsch:Fr. 1789		
<i>chrysoleucus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr.:Fr. 1815]	120	[154]
non <i>Agaricus chrysoleucus</i> Pers. 1801 [fide Fr. 1821, p. 167]		
<i>chrysophaeus</i> , <i>Agaricus</i> (<i>Pluteus</i>) [Schaeff.:Fr. 1774]	142	[188]

Taxon	Page	[Hym. Eur. page]
<i>chrysophyllus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr.:Fr. 1821]	122	[156]
<i>chrysorheus</i> , <i>Lactarius</i> [Fr. 1838, sp. nov.]	342	[428]
<i>cibarius</i> , <i>Cantharellus</i> [Fr.:Fr. 1821]	365	[455]
<i>cicatrissatus</i> , <i>Agaricus</i> (<i>Clitopilus</i>) [Lasch:Fr. 1828]	151	[200]
<i>cidaris</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1838, sp. nov.]	192	[255]
<i>cilicioides</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	334	[422]
= <i>Agaricus cilicioides</i> Fr.:Fr. 1821		
<i>cimmerius</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1821]	114	[146]
<i>cincinatus</i> [sic], <i>Agaricus</i> – See <i>cinninnatus</i> , <i>Agaricus</i>		
<i>cinninnatus</i> [' <i>cincinatus</i> '], <i>Agaricus</i> (<i>Hebeloma</i>) [Fr.:Fr. 1821]	172	[228]
<i>cinctulus</i> , <i>Agaricus</i> (<i>Panaeolus</i>) [Bolton 1792]	236	[(312)]
<i>cinerascens</i> , <i>Agaricus</i> (<i>Clitocybe</i>) <i>cyathiformis</i> var.		
[(Batsch) Fr. 1838, comb. nov.]	74	[100]
= <i>Agaricus cinerascens</i> Batsch 1786		
<i>cinerascens</i> , <i>Agaricus</i> (<i>Tricholoma</i>) ? [Bull. 1789, ' <i>cinerascens</i> ']	49	[73]
nom. illegit., non <i>Agaricus cinerascens</i> Batsch 1786		
<i>cinereus</i> , <i>Cantharellus</i> [Pers.:Fr. 1794]	366	[458]
= <i>Merulius cinereus</i> (Pers.:Fr.) Pers. 1798		
<i>cinereus</i> , <i>Coprinus fimetarius</i> var.		
[(Schaeff.) Fr. 1838, comb. nov.]	246	[324]
= <i>Agaricus cinereus</i> Schaeff.:Fr. 1774		
<i>cingulatus</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Ahnf. ex Fr.:Fr. 1830]	21	[42]
<i>cinnabarinus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>) [Fr. 1838, sp. nov.]	287	[370]
= <i>Agaricus purpureus</i> sensu Fr. 1821, sensu Lasch 1829, non Bull. ex Pers.:Fr. 1801		
<i>cinnabarinus</i> , <i>Hygrophorus</i>		
[(Schwein.) Fr. 1838, comb. nov., ' <i>cinnabarrinus</i> ']	329	[-]
= <i>Agaricus cinnabarinus</i> Schwein. 1822		
<i>cinnabarrinus</i> [sic], <i>Hygrophorus</i> – See <i>cinnabarinus</i> , <i>Hygrophorus</i>		
<i>cinnamomeus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>)		
[(L.:Fr.) Fr. 1838, comb. nov.]	288	[370]
= <i>Agaricus cinnamomeus</i> L.:Fr. 1753		
<i>circellatus</i> , <i>Lactarius</i> [1838, sp. nov.]	338	[426]
<i>cinninatus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr. 1838, sp. nov.]	132	[170]
nom. illegit., non <i>Agaricus circinatus</i> Schumach. 1803		
= <i>Agaricus ambiguus</i> Secr. 1833, nom. inval. et illegit., non Lasch 1828, nec Pers. 1828		
<i>cirrhatius</i> , <i>Agaricus</i> (<i>Collybia</i>) [(Pers.) Schumach. 1803]	89	[119]
= <i>Agaricus amanitae</i> γ <i>A. cirrhatus</i> Pers. 1800		
= <i>Agaricus tuberosus</i> β <i>A. cirrhatus</i> (Pers.) Pers. 1801		
<i>cirrhosus</i> , <i>Lentinus</i> [Afzel. ex Fr. 1837]	388	[-]
<i>citrinellus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Pers.:Fr. 1800]	116	[150]
<i>clandestinus</i> , <i>Agaricus</i> (<i>Nolanea</i>) [Fr.:Fr. 1818]	156	[207]
<i>claricolor</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Fr.) Fr. 1838, comb. nov.]	257	[336]
= <i>Agaricus multififormis</i> δ <i>claricolor</i> Fr. 1818		
<i>clavatus</i> , <i>Coprinus</i> [Fr. 1838, sp. nov.]	242	[321]
<i>clavicularis</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1821]	116	[149]

Taxon	Page	[Hym. Eur. page]
<i>clavipes</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Pers.:Fr. 1801]	56	[79]
<i>clavularis</i> , <i>Agaricus</i> (<i>Mycena</i>) <i>dilatatus</i> var. [(Batsch) Fr. 1838, comb. nov.]	117	[151]
= <i>Agaricus clavularis</i> Batsch 1786		
<i>clavus</i> , <i>Agaricus</i> (<i>Collybia</i>) [L.:Fr. 1753]	94	[123]
non <i>Agaricus clavus</i> Batsch 1789		
<i>clavus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Batsch 1789]	179	[239 sub <i>Agaricus</i>
nom. illegit., non <i>Agaricus clavus</i> L.:Fr. 1753		<i>claviceps</i>]
<i>cliduchus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.]	260	[340]
<i>Clitocybe</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	55, 597	[3, 78]
<i>Clitopilus</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	148, 598	[5, 197]
<i>clusii</i> , <i>Russula emetica</i> var. [Fr. 1838, nom. nov.]	358	[449]
= <i>Agaricus emeticus</i> Vittad. 1835, nom. illegit., non Schaeff.:Fr. 1774		
<i>clusilis</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, nom. nov.]	98	[129]
= <i>Agaricus umbilicatus</i> Bull. 1789, nom. illegit., non Scop. 1772, nec Schaeff. 1774		
<i>clypeatus</i> , <i>Agaricus</i> (<i>Entoloma</i>) [L. 1753]	146	[194]
<i>clypeolarius</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Bull.:Fr. 1789]	15	[32]
<i>cnista</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	50	[73]
<i>coccineus</i> , <i>Hygrophorus</i> [(Schaeff.:Fr.) Fr. 1836]	330	[417]
= <i>Agaricus coccineus</i> Schaeff.:Fr. 1774		
<i>coccola</i> , <i>Agaricus</i> (<i>Amanita</i>) [Scop. 1772]	3	[18]
<i>cochleatus</i> , <i>Lentinus</i> [(Pers.:Fr.) Fr. 1825]	394	[484]
= <i>Agaricus cochleatus</i> Pers.:Fr. 1793		
<i>cocles</i> , <i>Agaricus</i> (<i>Nolanea</i>) [Fr. 1838, sp. nov.]	158	[211]
coelestinus [sic], <i>Agaricus</i> – See <i>caelestinus</i> , <i>Agaricus</i>		
coerulea [sic], <i>Russula</i> – See <i>caerulea</i> , <i>Russula</i>		
coerulescens [sic], <i>Cortinarius</i> – See <i>caerulescens</i> , <i>Cortinarius</i>		
<i>coffeatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1821]	65	[89]
<i>cognatus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) <i>arcuatus</i> var. [Fr. 1838, var. nov.]	46	[70]
<i>cohaerens</i> , <i>Agaricus</i> (<i>Mycena</i>) [Pers.:Fr. 1801]	105	[137]
<i>collariatus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr. 1818]	114	[146]
<i>collinitus</i> , <i>Cortinarius</i> (<i>Myxadium</i>) [(Sowerby:Fr.) Fr. 1838, comb. nov.]	274	[354]
= <i>Agaricus collinitus</i> Sowerby:Fr. 1796–97		
<i>collinus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Scop.:Fr. 1772]	90	[119]
<i>Collybia</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	81, 597	[3, 109]
<i>colossus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1836]	38	[50]
<i>colubrinus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Krombh. 1831]	16	[34]
nom. illegit., non <i>Agaricus colubrinus</i> Bull. 1781–82		
<i>columbetta</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1821]	32	[55]
<i>colus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [(Paulet) Fr. 1838, comb. nov.]	308	[391]
= <i>Hypophyllum colus</i> Paulet ?1793		
<i>colymbadinus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>) [Fr. 1838, sp. nov.]	289	[372]

Taxon	Page	[Hym. Eur. page]
<i>comatus</i> , <i>Coprinus</i> [(O.F.Müll.:Fr.) Pers. 1797]	242	[320]
= <i>Agaricus comatus</i> O.F.Müll.:Fr. 1780		
<i>comitalis</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Pers.:Fr. 1801]	56	[80]
<i>commune</i> , <i>Schizophyllum</i> [Fr.:Fr. 1815]	403	[492]
<i>comosus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr. 1838, sp. nov.]	165	[220]
= <i>Agaricus villosus</i> sensu Bolton 1788, non Bull. 1785, nec Fr.:Fr. 1828		
<i>compar</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Weinm.) Fr. 1838, comb. nov.]	272	[353]
= <i>Agaricus compar</i> Weinm. 1836		
<i>compernis</i> , ? <i>Agaricus</i> (<i>Flammula</i>) [Fr. 1838, nom. nov.] . . .	183	[-]
= <i>Agaricus curvipes</i> Bertero & Mont. 1837, nom. illegit., non Pers. 1801		
<i>comtulus</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Fr. 1838, sp. nov.] . . .	215 ['521']	[281]
<i>concauus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Scop. 1772]	75	[102]
<i>conchatus</i> , <i>Panus</i> [(Bull.:Fr.) Fr. 1838, comb. nov.]	398	[488]
= <i>Agaricus conchatus</i> Bull.:Fr. 1787		
<i>confertus</i> , <i>Agaricus</i> (<i>Galera</i>) [Bolton:Fr. 1788]	206	[268]
<i>confluens</i> , <i>Agaricus</i> (<i>Collybia</i>) [Pers.:Fr. 1796]	88	[117]
<i>confragosus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr. 1838, sp. nov.]	169	[224]
<i>conglobatus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Vittad. 1835]	46	[69]
<i>congregatus</i> , <i>Coprinus</i> [(Bull.) Fr. 1838, comb. nov.]	249	[328]
= <i>Agaricus congregatus</i> Bull. 1781–82		
<i>conicus</i> , <i>Hygrophorus</i> [(Scop.:Fr.) Fr. 1838, comb. nov.] . . .	331	[419]
= <i>Agaricus conicus</i> Scop.:Fr. 1772		
<i>conigenus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Pers.:Fr. 1801]	89	[118]
<i>conissans</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr. 1838, nom. nov.]	187	[249]
= <i>Agaricus pulverulentus</i> Bull. 1783–84, nom. illegit., non Scop. 1772, nec Schaeff. 1774		
<i>connatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Schumach.:Fr. 1803]	66	[92]
<i>conocephalus</i> , <i>Agaricus</i> (<i>Galera</i>) [Bull.:Fr. 1792–93]	205	[334 as <i>Bolbitius conocephalus</i>]
<i>conopileus</i> ['conopilus'], <i>Agaricus</i> (<i>Psathyra</i>) [Fr.:Fr. 1821] . . .	231	[304]
= <i>Agaricus concephalus</i> Alb. & Schwein. 1805, non Bull.:Fr. 1792–93		
<i>conopilus</i> [sic], <i>Agaricus</i> – See <i>conopileus</i> , <i>Agaricus</i>		
<i>consobrina</i> , <i>Russula</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	359	[447]
= <i>Agaricus consobrina</i> Fr.:Fr. 1818		
<i>conspersus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Pers.:Fr. 1800]	201	[264]
<i>constrictus</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Fr.:Fr. 1821]	22	[42]
<i>contiguus</i> , <i>Lentinus lepidus</i> var. [Fr. 1838, var. nov.]	390	[482]
<i>contortus</i> , <i>Agaricus</i> (<i>Collybia</i>) <i>fusipes</i> var.		
[(Bull.) Fr. 1838, comb. nov.]	83	[112]
= <i>Agaricus contortus</i> Bull.:Fr. 1780–81		
<i>contortus</i> , <i>Lentinus</i> [Fr. 1836]	389	[482]
<i>controversus</i> , <i>Lactarius</i> [Pers.:Fr. 1800]	335	[423]
<i>coopertus</i> , <i>Coprinus</i> [Fr. 1838, sp. nov.]	252	[331]
<i>Coprinus</i> [Pers.:Fr. 1797]	241, 600	[7, 320]
<i>coprinus</i> , † <i>Agaricus</i> (<i>Psalliota</i>) [(Fr.:Fr.) Fr. 1821]	221	[278]
= <i>Amanita coprina</i> Fr.:Fr. 1818		

Taxon	Page	[Hym. Eur. page]
<i>coprophilus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Bull.:Fr. 1792–93]	229	[299]
<i>copulatus</i> , <i>Panus</i> [(Ehrenb.:Fr.) Fr. 1838, comb. nov.]	399	[-]
= <i>Agaricus copulatus</i> Ehrenb.:Fr. 1820		
<i>coracinus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	.95	[125]
<i>coriipellis</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr. 1838, sp. nov.]	131	[169]
<i>cornucopioides</i> , <i>Lentinus</i> [Klotzsch 1833]	392	[-]
<i>coronilla</i> [' <i>coronillus</i> '], <i>Agaricus</i> (<i>Pholiota</i>)		
[Bull. ex DC.:Fr. 1805]	163	[285 ' <i>coronillus</i> ']
<i>coronillus</i> [sic], <i>Agaricus</i> – See <i>coronilla</i> , <i>Agaricus</i>		
<i>corrosus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.] . . .	266	[347]
<i>corrugis</i> , <i>Agaricus</i> (<i>Psathyra</i>) [Pers.:Fr. 1794]	231	[305]
<i>corruscans</i> [sic], <i>Cortinarius</i> – See <i>coruscans</i> , <i>Cortinarius</i>		
<i>corticatus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr.:Fr. 1815]	129	[166]
<i>corticola</i> , <i>Agaricus</i> (<i>Mycena</i>) [Pers.:Fr. 1801]	118	[152]
= <i>Mycena corticola</i> (Pers.:Fr.) Gray 1821		
<i>Cortinarius</i> [(Pers.) Gray 1821]	255, 600	[8, 335]
<i>cortinatus</i> , <i>Agaricus</i> (<i>Flammula</i>) [DC. 1815]	186	[248]
<i>cortinellus</i> , <i>Agaricus</i> (<i>Flammula</i>) <i>cortinatus</i> var.		
[(DC.) Fr. 1838, comb. nov.]	186	[248]
= <i>Agaricus cortinellus</i> DC. 1815		
<i>coruscans</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov., ' <i>corruscans</i> ']	271	[352 ' <i>corruscans</i> ']
= <i>Agaricus coruscans</i> Fr.:Fr. 1821		
<i>coryphaeus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	.26	[48]
<i>cossus</i> , <i>Hygrophorus</i> [(Sowerby) Fr. 1838, comb. nov.]	321	[406]
= <i>Agaricus cossus</i> Sowerby 1798–99		
<i>costatus</i> , <i>Agaricus</i> (<i>Entoloma</i>) [(Fr.) Fr. 1838, comb. nov.] . .	147	[196]
nom. illegit., non <i>Agaricus costatus</i> Krombh. 1831, nec Wallr. 1833		
= <i>Agaricus pascuus</i> β <i>costatus</i> Fr.:Fr. 1821		
= <i>Agaricus costatus</i> (Fr.) Secr. 1833, nom. inval.		
<i>cothurnatus</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Fr. 1838, sp. nov.]	218	[290]
<i>cotoneus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>) [Fr. 1838, sp. nov.] . . .	289	[372]
= <i>Agaricus notatus</i> Secr. 1833, nom. inval. et illegit., non Pers. 1801		
<i>crampylus</i> , <i>Lactarius</i> [(J.Otto:Fr.) Fr. 1838, comb. nov., ' <i>campylus</i> ']	334	[423]
= <i>Agaricus crampylus</i> J.Otto:Fr. 1816		
<i>craspedius</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr.:Fr. 1821]	131	[169]
<i>crassus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.] . . .	257	[337]
<i>crassus</i> , <i>Paxillus</i> [Fr. 1838, sp. nov.]	318	[404]
<i>craticius</i> , <i>Cortinarius</i> (<i>Inoloma</i>) [Fr. 1838, sp. nov.]	282	[364]
<i>cremor</i> , <i>Lactarius</i> [Fr. 1838, sp. nov.]	343	[432]
<i>crenatus</i> , <i>Agaricus</i> (<i>Psathyrella</i>) [Lasch:Fr. 1828]	240	[315]
<i>crenulatus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Schumach.:Fr. 1803]	100	[131]
<i>Crepidotus</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	[160], 209, 599	[6, 275]
<i>cretaceus</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Bull.:Fr. 1788]	213	[35 sub <i>A. cepistipes</i> ; 279 'non Bull.']
= <i>Pluteus cretaceus</i> (Bull.:Fr.) Fr. 1836		

Taxon	Page	[Hym. Eur. page]
<i>crinitus</i> , <i>Lentinus</i> [(L.:Fr.) Fr. 1825]	389	[-]
= <i>Agaricus crinitus</i> L.:Fr. 1763		
<i>crispatulus</i> , <i>Cantharellus crispus</i> var.		
[Schwein. ex Fr. 1838, var. nov.]	369	[-]
<i>crispus</i> , <i>Cantharellus</i> [Pers.:Fr. 1794]	369	[492 as <i>Trogia crispa</i>]
= <i>Merulius crispus</i> (Pers.:Fr.) Pers. 1800		
<i>cristallinus</i> , <i>Cortinarius (Phlegmacium)</i> [Fr. 1838, nom. nov.]	270	[350]
= <i>Agaricus barbatus</i> Batsch:Fr. 1783		
<i>cristatus</i> , <i>Agaricus (Lepiota)</i> [Bolton:Fr. 1788]	15	[32 'Alb. & Schwein.']
<i>crobulus</i> , <i>Agaricus (Naucoria)</i> [Fr. 1838, nom. nov.]	199	[274]
= <i>Agaricus squarrosus</i> Bull. 1792, nom. illegit., non Vahl:Fr. 1770		
= <i>Agaricus inquilinis</i> β <i>squarrosulus</i> Fr.:Fr. 1828		
<i>crocatus</i> , <i>Agaricus (Mycena)</i> [Schräd.:Fr. 1794]	115	[148]
<i>croceocaeruleus</i> , <i>Cortinarius (Phlegmacium) cumatilis</i> var.		
[(Pers.) Fr. 1838, comb. nov., 'croceocoeruleus']	269	[352 as <i>Cortinarius</i> <i>croceocaeruleus</i>]
= <i>Agaricus croceocaeruleus</i> Pers.:Fr. 1798		
<i>croceocoeruleus</i> [sic], <i>Cortinarius cumatilis</i> – See <i>croceocaeruleus</i> , <i>Cortinarius cumatilis</i>		
<i>croceofulvus</i> , <i>Cortinarius (Telamonia)</i>		
[(DC.:Fr.) Fr. 1838, comb. nov.]	296	[379]
= <i>Agaricus croceofulvus</i> DC.:Fr. 1815		
<i>croceus</i> , <i>Cortinarius (Dermocybe) cinnamomeus</i> var.		
[(Schaeff.) Fr. 1838, comb. nov.]	288	[371]
= <i>Agaricus croceus</i> Schaeff.:Fr. 1774		
<i>crucibulum</i> , <i>Cantharellus</i> [(Fr.) Fr. 1838, comb. nov.]	369	[461]
= <i>Merulius crucibulum</i> Fr. 1815		
<i>cruentus</i> , <i>Agaricus (Mycena)</i> [Fr.:Fr. 1821]	115	[148]
<i>crustuliniformis</i> , <i>Agaricus (Hebeloma)</i> [Bull. 1787]	180	[241]
<i>cryptarum</i> , <i>Nyctalis</i> [Fr. 1838, sp. nov.]	371	[463]
= <i>Agaricus cryptophyllus</i> Secr. 1833, nom. inval.		
<i>crysodon</i> [sic], <i>Hygrophorus</i> – See <i>chrysodon</i> , <i>Hygrophorus</i>		
<i>cucumis</i> , <i>Agaricus (Naucoria)</i> [Pers.:Fr. 1796]	193	[255]
<i>cudon</i> , <i>Agaricus (Entoloma)</i> [Fr. 1836]	144	[191]
<i>cumatilis</i> , <i>Cortinarius (Phlegmacium)</i> [Fr. 1838, sp. nov.]	269	[349]
= <i>Agaricus personatus</i> Secr. 1833, nom. inval. et illegit., non Fr.:Fr. 1818		
<i>cuneifolis</i> [sic], <i>Agaricus</i> – See <i>cuneifolius</i> , <i>Agaricus</i>		
<i>cuneifolius</i> [' <i>cuneifolis</i> '], <i>Agaricus (Tricholoma)</i> [Fr.:Fr. 1818]	37	[61]
<i>cupularis</i> , <i>Agaricus (Omphalia)</i> [Bull. ex Pers.:Fr. 1801]	121	[272]
<i>cupularis</i> , <i>Cantharellus</i> [(Wahlenb.:Fr.) Fr. 1821]	369	[462 as <i>Arrhenia</i> <i>cupularis</i>]
= <i>Merulius cupularis</i> Wahlenb.:Fr. 1812		
<i>cupulatus</i> , <i>Cantharellus</i> [Fr. 1838, nom. nov.]	367	[458]
= <i>Agaricus helvelloides</i> Bull. ex Bull. & Vent. 1809		
<i>curtipes</i> , <i>Agaricus (Clitocybe)</i> [Fr.:Fr. 1821]	58	[81]
<i>curvipes</i> , <i>Agaricus (Pholiota)</i> [Alb. & Schwein. 1805]	168	[223]
nom. illegit., non <i>Agaricus curvipes</i> Pers. 1801		
<i>cyanellus</i> [sic], <i>Agaricus</i> – See <i>cyanulus</i> , <i>Agaricus</i>		
<i>cyanites</i> , <i>Cortinarius (Inoloma)</i> [Fr. 1838, sp. nov.]	279	[360]

Taxon	Page	[Hym. Eur. page]
<i>cyanofilopes</i> , [†] <i>Agaricus</i> [Secr. 1833, nom. inval.]	159	[202 'cyanofilipes', sub <i>Agaricus lampropus</i> * <i>cyanulus</i>]
<i>cyanopus</i>, <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[Secr. ex Fr. 1838, sp. nov.]	258	[338]
= <i>Agaricus cyanopus</i> Secr. 1833, nom. inval.		
<i>cyanulus</i> ['cyanellus'], [†] <i>Agaricus</i> [Lasch 1829]	159	[202 as <i>Agaricus lampropus</i> * <i>cyanulus</i>]
<i>cyathiformis</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Bull.:Fr. 1792]	73	[100]
<i>cyathiformis</i>, <i>Panus</i> [(Schaeff.) Fr. 1838, comb. nov.]	397	[488]
= <i>Agaricus cyathiformis</i> Schaeff. 1774, non Bull.:Fr. 1792		
= <i>Agaricus schaefferi</i> Weinm. 1836, nom. illegit., non Fr.:Fr. 1821		
<i>cyathula</i>, <i>Lactarius</i> [(Fr.) Fr. 1838, comb. nov.]	344	[433]
= <i>Agaricus vietus</i> β <i>cyathula</i> Fr.:Fr. 1821		
<i>cyclodes</i>, <i>Coprinus</i> [Fr. 1838, sp. nov.]	250	[329]
<i>cylindraceus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [DC. 1815]	164	[218]
<i>cylindricus</i>, <i>Coprinus</i> [(Schaeff.:Fr.) Fr. 1838, comb. nov.]	244	[322]
= <i>Agaricus cylindricus</i> Schaeff.:Fr. 1774		
<i>cyphellaeformis</i> [sic], <i>Agaricus</i> – See <i>cyphelliformis</i> , <i>Agaricus</i>		
<i>cyphelliformis</i> ['cyphellaeformis'], <i>Agaricus</i> (<i>Pleurotus</i>)		
[Berk. 1837]	137	[180 'cyphellaeformis']
<i>cypriacus</i>, <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.]	307	[390]
D		
<i>damaeus</i>, <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.]	304	[387]
<i>dealbatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Sowerby:Fr. 1798–99]	63	[88]
<i>debilis</i>, <i>Agaricus</i> (<i>Mycena</i>) [Fr. 1838, sp. nov.]	112	[145]
<i>decastes</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1818]	65	[90]
<i>decipiens</i> , [†] <i>Agaricus</i> [Scop. 1770]	346	[438]
unavailable name, non <i>Agaricus decipiens</i> Pers.:Fr. 1801		
<i>decipiens</i>, <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Pers.:Fr.) Fr. 1838, comb. nov.]	312	[396]
= <i>Agaricus decipiens</i> Pers.:Fr. 1801		
<i>declinis</i> , <i>Agaricus</i> (<i>Collybia</i>) [Weinm. 1835]	87	[116]
<i>decolorans</i>, <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Pers.) Fr. 1838, comb. nov.]	271	[351]
= <i>Agaricus decolorans</i> Pers. 1796, non Fr.:Fr. 1821		
<i>decolorans</i>, <i>Russula</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	361	[451]
= <i>Agaricus decolorans</i> Fr.:Fr. 1821		
<i>decoloratus</i>, <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	270	[351]
= <i>Agaricus decoloratus</i> Fr.:Fr. 1821		
<i>decorus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr.:Fr. 1821]	130	[168]
<i>decumbens</i>, <i>Cortinarius</i> (<i>Dermocybe</i>)		
[(Pers.) Fr. 1838, comb. nov.]	284	[366]
= <i>Agaricus decumbens</i> Pers. 1801		

Taxon	Page	[Hym. Eur. page]
<i>decussatus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr. 1838, sp. nov.]	185	[246]
<i>degener</i> , <i>Xerotus</i> [(Schaeff.) Fr. 1838, comb. nov.]	400	[491]
= <i>Agaricus degener</i> Schaeff. 1774		
<i>deglubens</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr. 1838, sp. nov.]	173	[230]
<i>delastrei</i> , <i>Panus</i> [(Mont.) Fr. 1838, comb. nov., 'delastri']	400	[491 'delastri']
= <i>Agaricus delastrei</i> Mont. 1837		
delastri [sic], <i>Panus</i> – See <i>delastrei</i> , <i>Panus</i>		
<i>delibutus</i> , <i>Cortinarius</i> (<i>Myxacium</i>) [Fr. 1838, sp. nov.]	276	[357]
<i>delica</i> , <i>Russula</i> [Fr. 1838, sp. nov.]	350	[440]
<i>delicatus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Fr.:Fr. 1821]	20	[39]
<i>deliciosus</i> , <i>Lactarius</i> [(L.:Fr.) Gray 1821]	341	[431]
= <i>Agaricus deliciosus</i> L.:Fr. 1753		
<i>deliquescent</i> , <i>Coprinus</i> [(Bull.:Fr.) Fr. 1838, comb. nov.]	249	[327]
= <i>Agaricus deliquescent</i> Bull.:Fr. 1790		
demissannulus [sic], <i>Agaricus</i> – See <i>demissannulus</i> , <i>Agaricus</i>		
<i>demissannulus</i> , <i>Agaricus</i> (<i>Lepiota</i>)		
[Secr. ex Fr. 1838, sp. nov., 'demissannulus']	19	[38 'demissannulus']
= <i>Agaricus demissannulus</i> Secr. 1833, nom. inval.		
<i>demissus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1821]	80[bis]	[160]
<i>denigratus</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Pers.:Fr. 1801]	23	[45]
<i>depallens</i> , <i>Russula</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	353	[442]
= <i>Agaricus Russula depallens</i> Pers.:Fr. 1801		
<i>depexus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	291	[373]
= <i>Agaricus depexus</i> Fr.:Fr. 1818		
deplanata [sic], <i>Lenzites</i> – See <i>deplanatus</i> , <i>Lenzites</i>		
<i>deplanatus</i> , <i>Lenzites</i>		
[(Link ex Fr.:Fr.) Fr. 1838, comb. nov., 'deplanata']	404	[-]
= <i>Daedalea deplanata</i> Link ex Fr.:Fr. 1830		
<i>depluens</i> , <i>Agaricus</i> (<i>Crepidotus</i>) [Batsch:Fr. 1786]	212	[214]
<i>depressus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, nom. nov.]	314	[398]
= <i>Agaricus cucumis</i> β <i>hemisphaericus</i> Fr. 1815		
<i>Dermocybe</i> , <i>Cortinarius</i> "trib."		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	283, 600	[8, 365]
= <i>Agaricus trib. Dermocybe</i> Fr.:Fr. 1821		
<i>descendens</i> , <i>Lentinus</i> (<i>Scleroma</i>) [Fr. 1837]	390	[-]
<i>descissus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr. 1838, sp. nov.]	174	[233]
<i>strictus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) <i>rimosus</i> var.		
[Fr. 1838, var. nov.]	174	[232 as <i>Agaricus destructus</i>]
<i>destruens</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Brond. 1828]	164	[219]
<i>detonsus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	313	[397]
= <i>Agaricus detonsus</i> Fr.:Fr. 1821		
<i>devexus</i> , <i>Cantharellus replexus</i> var.		
[(Fr.) Fr. 1838, comb. nov.]	367	[459]
= <i>Agaricus devexus</i> Fr.:Fr. 1821		

Taxon	Page	[Hym. Eur. page]
<i>diabolicus, Cortinarius (Dermocybe)</i>		
[(Fr.) Fr. 1838, comb. nov.]	285	[367]
= <i>Agaricus anomalus</i> δ <i>diabolicus</i> Fr.:Fr. 1821		
= <i>Agaricus diabolicus</i> (Fr.) Secr. 1833, nom. inval.		
<i>diatretus, Agaricus (Clitocybe)</i> [Fr.:Fr. 1818]	78	[104]
<i>dibaphus, Cortinarius (Phlegmacium)</i> [Fr. 1838, sp. nov.] . .	266	[346]
= <i>Agaricus luteopes</i> Secr. 1833, nom. inval.		
<i>dichrous, Agaricus (Entoloma)</i> [Pers.:Fr. 1801]	146	[194]
<i>dictyorrhizus, Agaricus (Pleurotus)</i> [DC.:Fr. 1806]	136	[178]
<i>difformis, Agaricus (Clitocybe)</i> [Pers.:Fr. 1801]	79	[106]
<i>difformis, Agaricus (Clitocybe) cerussatus</i> var.		
[(Schumach.:Fr.) Fr. 1821]	61	[86]
= <i>Agaricus difformis</i> Schumach. 1803		
<i>diffRACTus, Agaricus (Hebeloma)</i> [Fr. 1838, sp. nov.]	182	[242]
<i>digitalis, Coprinus</i> [(Batsch) Fr. 1838, comb. nov.]	249	[327]
= <i>Agaricus digitalis</i> Batsch 1783		
<i>dilatatus, Agaricus (Mycena)</i> [Fr. 1815]	117	[151]
<i>dilectus, Coprinus</i> [Fr. 1838, sp. nov.]	250	[328]
<i>dilutus, Cortinarius (Hydrocybe)</i> [(Pers.) Fr. 1838, comb. nov.]	305	[389]
= <i>Agaricus [Cortinaria] dilutus</i> Pers. 1801, p. 300,		
non <i>Agaricus [Lepiota] dilutus</i> Pers. 1801, p. 261		
= <i>Agaricus armeniacus</i> γ <i>A. dilutus</i> (Pers.:Fr.) Fr. 1821		
<i>discoideus, Hygrophorus</i> [(Pers.:Fr.) Fr. 1838, comb. nov.] . .	323	[408]
= <i>Agaricus discoideus</i> Pers.:Fr. 1801		
<i>discretus, Agaricus (Mycena)</i> [Fr.:Fr. 1828]	104	[–]
<i>dispar</i> , † <i>Agaricus</i> ? [sub <i>Marasmius</i>] [Batsch 1789]	378	[471 ‘† <i>Marasmius</i>
<i>dispar</i> (nom. illegit., non Fr. 1838)]		
<i>dispar, Marasmius</i> [Fr. 1838, nom. nov.]	382	[–]
= <i>Agaricus dispar</i> Mont. 1834, nom. illegit., non Batsch 1789		
<i>dispersus, Agaricus (Hypholoma)</i> [Fr. 1838, nom. nov.] 222 [‘122’]		[292]
= <i>Agaricus marginatus</i> Pers. 1796, nom. illegit., non Batsch 1789		
= <i>Agaricus fascicularis</i> γ <i>A. marginatus</i> Pers.:Fr. 1801		
<i>disseminatus, Agaricus (Psathyrella)</i> [Pers.:Fr. 1800]	240	[316]
<i>dissiliens, Agaricus (Mycena)</i> [Fr. 1838, nom. nov.]	108	[141]
= <i>Agaricus pseudoclypeatus</i> Bolton 1792		
<i>distortus, Agaricus (Collybia)</i> [Fr. 1838, sp. nov.]	84	[113]
<i>ditopus, Agaricus (Clitocybe)</i> [Fr.:Fr. 1815]	77	[104]
<i>djamor, Lentinus</i> [(Rumph. ex Fr.:Fr.) Fr. 1836]	395	[–]
= <i>Agaricus djamor</i> Rumph. ex Fr.:Fr. 1821		
<i>dolabratus, Cortinarius (Hydrocybe)</i> [Fr. 1838, sp. nov.] . . .	311	[394]
<i>domesticus, Coprinus</i> [(Bolton:Fr.) Gray 1821]	251	[330 ‘non Bolton’]
= <i>Agaricus domesticus</i> Bolton:Fr. 1788		
<i>dorsalis, Panus</i> [(Bosc:Fr.) Fr. 1838, comb. nov.]	399	[–]
= <i>Agaricus dorsalis</i> Bosc:Fr. 1811		
<i>dryinus, Agaricus (Pleurotus)</i> [Pers.:Fr. 1800]	129	[167]
<i>dryophilus, Agaricus (Collybia)</i> [Bull.:Fr. 1790]	92	[122]

Taxon	Page	[Hym. Eur. page]
<i>dulcamarus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Alb. & Schwein. 1805] . . .	171	[228]
nom. illegit., non <i>Agaricus dulcamarus</i> Pers. 1801		
<i>dunalii</i> , <i>Lentinus</i> [(DC.:Fr.) Fr. 1825]	390	[481 as <i>Lentinus tigrinus</i> * <i>dunalii</i>]
≡ <i>Agaricus dunalii</i> DC.:Fr. 1815		
<i>dunalii</i> , <i>Montagnites</i> [Fr. 1838, sp. nov.]	241	[320 sub <i>Montagnites candollei</i>]
≡ <i>Agaricus ocreatus</i> sensu Dunal [?year], non Holmsk.:Fr. 1799		
<i>duracinus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.] . . .	304	[388]
<i>durus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Bolton 1788]	162	[216]
E		
<i>eburneus</i> , <i>Hygrophorus</i> [(Bull.:Fr.) Fr. 1836]	321	[406]
≡ <i>Agaricus eburneus</i> Bull.:Fr. 1782–83		
<i>ecbolus</i> , <i>Agaricus</i> (<i>Naucoria</i>) <i>inquilinus</i> var.		
[Fr. 1838, var. nov.]	199	[275]
<i>Eccilia</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	159, 598	[5, 211]
<i>echinatus</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Roth:Fr. 1800]	215 ['521']	[282]
<i>echinipes</i> , <i>Agaricus</i> (<i>Mycena</i>) [Lasch:Fr. 1828]	117	[152]
<i>echinocephalus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Vittad. 1835]	16	[22]
<i>ectypus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1821]	80	[107]
<i>elaeodes</i> , <i>Agaricus</i> (<i>Hypholoma</i>) [Fr. 1838, sp. nov.] . . .	222 ['122']	[291]
<i>elatiior</i> , <i>Cortinarius</i> (<i>Myxacium</i>) [Fr. 1838, sp. nov.]	274	[355]
≡ <i>Agaricus elatus</i> sensu Pers. 1801, non Batsch:Fr. 1789		
<i>elatus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Batsch:Fr. 1789]	181	[241]
<i>elegans</i> , <i>Agaricus</i> (<i>Mycena</i>) [Pers.:Fr. 1801]	100	[131]
<i>elegantior</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Fr.) Fr. 1838, comb. nov.]	267	[348]
≡ <i>Agaricus multiformis</i> β <i>elegantior</i> Fr. 1818		
<i>elephantina</i> , <i>Russula</i> [(Bolton) Fr. 1838, comb. nov.]	350	[440]
≡ <i>Agaricus elephantinus</i> Bolton 1788		
≡ <i>Agaricus adustus</i> δ <i>elephantinus</i> (Bolton:Fr.) Fr. 1821		
<i>elevatus</i> , <i>Agaricus</i> (<i>Collybia</i>) <i>longipes</i> var.		
[(Weinm.) Fr. 1838, comb. nov.]	82	[110 as <i>Agaricus elevatus</i>]
≡ <i>Agaricus elevatus</i> Weinm. 1835		
<i>elodes</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Fr.:Fr. 1821]	144	[191 'helodes']
<i>elongatus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) <i>udus</i> var.		
[(Pers.:Fr.) Fr. 1821]	228	[298]
≡ <i>Agaricus elongatus</i> Pers. 1798		
<i>elotus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.]	264	[344]
<i>elytroides</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Scop. 1772]	39	[62]
<i>embolus</i> , <i>Agaricus</i> (<i>Galera</i>) [Fr. 1838, sp. nov.]	206	[274]
<i>emetica</i> , <i>Russula</i> [(Schaeff.:Fr.) Pers. 1796]	357	[448]
≡ <i>Agaricus emeticus</i> Schaeff.:Fr. 1774		
<i>emollitus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.] . .	269	[350]
<i>enunctus</i> , <i>Cortinarius</i> (<i>Myxacium</i>) [Fr. 1838, sp. nov.]	275	[356]
<i>enchymosus</i> , <i>Agaricus</i> (<i>Naucoria</i>) <i>centunculus</i> var.		
[Fr. 1838, var. nov.]	194	[256 as <i>Agaricus enchymosus</i>]

Taxon	Page	[Hym. Eur. page]
<i>Entoloma</i> , <i>Agaricus</i> “trib.” [Fr. 1838, “trib.” nov.]	143, 598	[4, 189]
<i>ephebeus</i> , <i>Agaricus</i> (<i>Pluteus</i>) [Fr.:Fr. 1818]	141	[186]
<i>ephemeroides</i> , <i>Coprinus</i> [(Bull.:Fr.) Fr. 1838, comb. nov.]	250	[328]
= <i>Agaricus ephemeroides</i> Bull.:Fr. 1792–93		
<i>ephemerus</i> , <i>Coprinus</i> [(Bull.:Fr.) Fr. 1838, comb. nov.]	252	[331]
= <i>Agaricus ephemerus</i> Bull.:Fr. 1792		
<i>ephippium</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	85	[114]
<i>epibryus</i> , <i>Agaricus</i> (<i>Crepidotus</i>) [Fr.:Fr. 1821]	211	[277]
<i>epichysium</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Pers.:Fr. 1794]	123	[158]
<i>epiphyllus</i> , <i>Marasmius</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	386	[479]
= <i>Agaricus epiphyllus</i> Pers.:Fr. 1801		
<i>epipoleus</i> , <i>Cortinarius</i> (<i>Myxacium</i>) [Fr. 1838, sp. nov.]	277	[358]
<i>epipterygius</i> , <i>Agaricus</i> (<i>Mycena</i>) [Scop.:Fr. 1772]	116	[149]
= <i>Mycena epipterygia</i> (Scop.:Fr.) Gray 1821		
<i>epixanthus</i> , <i>Agaricus</i> (<i>Hypholoma</i>) [Fr. 1838, sp. nov.]	222 [‘122’]	[291]
<i>equestris</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [L.:Fr. 1753]	26	[48]
<i>erebius</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr.:Fr. 1821]	162	[216]
<i>ericaeus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Pers.:Fr. 1801]	228	[298]
<i>ericetorum</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1838, sp. nov.]	73	[99]
nom. illegit. non <i>Agaricus ericetorum</i> Pers.:Fr. 1796		
= <i>Agaricus ericetosus</i> Bull. 1792, pro parte		
<i>erinaceus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1828]	201	[263]
<i>ermineus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Fr.:Fr. 1821]	15	[33]
<i>erosus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr.:Fr. 1821]	98	[129]
<i>erubescens</i> , <i>Hygrophorus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	322	[407]
= <i>Agaricus erubescens</i> Fr.:Fr. 1821		
<i>erugatus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Weinm.) Fr. 1838, comb. nov.]	306	[389]
= <i>Agaricus erugatus</i> Weinm. 1836		
<i>eryngii</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [DC.:Fr. 1815]	132	[171]
<i>erythrinus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Fr.) Fr. 1838, comb. nov.]	312	[396]
= <i>Agaricus castaneus</i> δ <i>erythrinus</i> Fr. 1818		
<i>erythropus</i> , <i>Marasmius</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	378	[470]
= <i>Agaricus erythropus</i> Pers.:Fr. 1801		
<i>escharioides</i> [‘ <i>escharoides</i> ’], <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1818]	201	[264 ‘ <i>escharoides</i> ’]
<i>escharoides</i> [sic], <i>Agaricus</i> – See <i>escharioides</i> , <i>Agaricus</i>		
<i>esculentus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Wulfen:Fr. 1781]	92	[121]
<i>euchlorus</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Lasch ex Fr. 1838, sp. nov.]	154	[204]
<i>euchrous</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Pers.:Fr. 1801]	153	[203]
<i>eugrammus</i> , <i>Lentinus</i> [(Mont.) Fr. 1838, comb. nov.]	396	[–]
= <i>Agaricus eugrammus</i> Mont. 1837		
<i>evernius</i> , <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	294	[377]
= <i>Agaricus evernius</i> Fr.:Fr. 1818		
<i>excelsus</i> , <i>Agaricus</i> (<i>Amanita</i>) [Fr.:Fr. 1821]	8	[21]

Taxon	Page	[Hym. Eur. page]
<i>excisus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Lasch:Fr. 1829]	105	[137]
<i>excoriatus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Schaeff.:Fr. 1774]	13	[30]
= <i>Lepiota procera</i> β <i>excoriata</i> (Schaeff.) Gray 1821		
<i>exilis</i> , <i>Agaricus</i> (<i>Nolanea</i>) [Fr.:Fr. 1818]	158	[210]
<i>exilis</i> , <i>Lentinus</i> (<i>Scleroma</i>) [Klotzsch ex Fr. 1836]	393	[-]
<i>expallens</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Pers.:Fr. 1801]	74	[100]
<i>expolitus</i> , <i>Agaricus</i> (<i>Psathyrella</i>) <i>atomatus</i> var.		
[Fr. 1838, var. nov.]	240	[315]
<i>excissus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1821]	52	[75]
<i>exsculptus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	93	[123]
<i>extinctorius</i> [sic], <i>Coprinus</i> – See <i>extinctorius</i> , <i>Coprinus</i>		
<i>extenuatus</i> , <i>Paxillus</i> [(Scop.) Fr. 1838, comb. nov.]	316	[402]
= <i>Agaricus extenuatus</i> Scop. 1772		
<i>extinctorius</i> , <i>Coprinus</i>		
[(Bull.) Fr. 1838, comb. nov., 'extinctorius']	245	[324 'extinctorius']
= <i>Agaricus extinctorius</i> Bull. 1790		
<i>extuberans</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	93	[123]
F		
<i>fagetorum</i> , <i>Agaricus</i> (<i>Mycena</i>) <i>excisus</i> var.		
[Fr. 1838, var. nov.]	106	[138]
<i>fagicola</i> , <i>Agaricus</i> (<i>Psathyra</i>) [Lasch:Fr. 1828]	233	[306]
<i>falkii</i> , <i>Agaricus</i> (<i>Psathyra</i>) [Weinm. 1836]	233	[307]
<i>fallax</i> , <i>Russula emetica</i> var. [(Fr.:Fr.) Fr. 1821]	358	[449]
= <i>Agaricus fallax</i> Fr. 1815		
<i>farinaceus</i> , <i>Panus</i> [(Schumach.:Fr.) Fr. 1838, comb. nov.]	399	[490]
= <i>Agaricus farinaceus</i> Schumach.:Fr. 1803		
<i>farinosus</i> , <i>Agaricus</i> (<i>Amanita</i>) [(Schwein.) Fr. 1838, comb. nov.]	11	[-]
= <i>Amanita farinosa</i> Schwein. 1822		
<i>farneus</i> , <i>Panus</i> [Fr. 1838, sp. nov.]	397	[487]
<i>farreus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Lasch ex Fr. 1838, sp. nov.]	103	[134]
<i>fasciatus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Scop.) Fr. 1838, comb. nov.]	315	[399]
= <i>Agaricus fasciatus</i> Scop. 1772		
<i>fascicularis</i> , <i>Agaricus</i> (<i>Hypholoma</i>) [Huds.:Fr. 1778] . . 222 ['122']		[291]
<i>fascinans</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	336	[424]
= <i>Agaricus fascinans</i> Fr.:Fr. 1821		
<i>fastibilis</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Pers.:Fr. 1801]	178	[237]
<i>fastigiatus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Schaeff. 1774]	174	[231]
<i>fatuus</i> , <i>Agaricus</i> (<i>Psathyra</i>) [(Fr.) Fr. 1838, comb. nov.]	233	[308]
= <i>Agaricus stipatus</i> γ <i>fatuus</i> Fr.:Fr. 1821		
<i>faveolaris</i> , <i>Marasmius</i> [Fr. ex Mont. 1836]	385	[477]
<i>favillaris</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	54	[78]
<i>fellea</i> , <i>Russula</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	354	[447]
= <i>Agaricus felleus</i> Fr.:Fr. 1821		

Taxon	Page	[Hym. Eur. page]
<i>ferrugineus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) <i>turbinatus</i> var. [(Scop.) Fr. 1838, comb. nov.]	266	[347]
= <i>Agaricus ferrugineus</i> Scop. 1772		
<i>festivus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1838, sp. nov.]	192	[253]
<i>fibrillosus</i> , <i>Agaricus</i> (<i>Psathyra</i>) [Pers.:Fr. 1801]	233	[308]
<i>fibula</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Bull.:Fr. 1783–84]	127	[164]
<i>filamentosus</i> , <i>Agaricus</i> (<i>Pholiota</i>) <i>aurivellus</i> var. [Fr. 1838, var. nov.]	165	[220]
= <i>Agaricus filamentosus</i> sensu Schaeff. 1774, non Scop. 1772		
<i>filamentosus</i> , <i>Paxillus</i> [(Scop.) Fr. 1838, comb. nov.]	317	[403 sub <i>Paxillus</i> <i>leptopus</i>]
= <i>Agaricus filamentosus</i> Scop. 1772		
<i>filopes</i> , <i>Agaricus</i> (<i>Mycena</i>) [Bull.:Fr. 1787–88]	112	[144]
<i>fimbriatus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Bolton:Fr. 1788]	131	[169]
<i>finetarius</i> , <i>Coprinus</i> [(L.) Fr. 1838, comb. nov.]	245	[324]
= <i>Agaricus finetarius</i> L. 1753		
<i>fimicola</i> , <i>Agaricus</i> (<i>Panaeolus</i>) [Fr.:Fr. 1821]	237	[312]
<i>fimiputris</i> , <i>Agaricus</i> (<i>Panaeolus</i>) [Bull.:Fr. 1781–82]	235	[310]
<i>firmus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, nom. nov.]	303	[386]
= <i>Agaricus firmus</i> Weinm. 1836, nom. illegit., non Pers. 1798		
<i>flabellare</i> , <i>Schizophyllum</i> [Fr. 1838, sp. nov.]	403	[–]
= 'Fr. Afz. Guin. t. XI. f. 25' [ined.]		
<i>flabelliformis</i> , <i>Lentinus</i> [(Bolton:Fr.) Fr. 1825]	395	[487]
= <i>Agaricus flabelliformis</i> Bolton:Fr. 1792		
<i>flabellus</i> , <i>Cortinarius</i> (<i>Telamonia</i>) [(Fr.:Fr.) Fr. 1838, comb. nov.]	300	[384]
= <i>Agaricus flabellus</i> Fr.:Fr. 1821		
<i>flaccida</i> [sic], <i>Lenzites</i> – See <i>flaccidus</i> , <i>Lenzites</i>		
<i>flaccidus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Sowerby:Fr. 1798–99]	71	[97]
<i>flaccidus</i> , <i>Lenzites</i> [Fr. 1838, sp. nov., 'flaccida']	406	[493 'flaccida']
<i>flammans</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Batsch:Fr. 1783]	167	[222]
<i>flammeolus</i> , <i>Lactarius</i> [(Pollini:Fr.) Fr. 1838, comb. nov.]	341	[436]
= <i>Agaricus flammeolus</i> Pollini:Fr. 1816		
<i>Flammula</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	182, 599	[6, 244]
<i>flavidus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Schaeff.:Fr. 1774]	187	[248]
<i>flavoalbus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr. 1838, nom. nov.]	103	[135]
= <i>Agaricus pumilus</i> Bull. 1786, non Pers.:Fr. 1801		
= <i>Agaricus lacteus</i> β <i>pumilus</i> (Bull.:Fr.) Fr. 1821		
<i>flavobrunneus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1818]	28	[51]
<i>flexipes</i> , <i>Cortinarius</i> (<i>Telamonia</i>) [(Pers.:Fr.) Fr. 1838, comb. nov.]	300	[384]
= <i>Agaricus flexipes</i> Pers.:Fr. 1801		
<i>flexuosus</i> , <i>Lactarius</i> [Fr. 1838, sp. nov.]	338	[427]
nom. illegit., non <i>Lactarius flexuosus</i> (Pers.:Fr.) Gray 1821		
= <i>Agaricus flexuosus</i> sensu Fr. 1815, non Pers.:Fr. 1801		
<i>floccipes</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	87	[116]

Taxon	Page	[Hym. Eur. page]
<i>flocculosus</i> , <i>Coprinus</i> [(DC.:Fr.) Fr. 1838, comb. nov.]	245	[323]
= <i>Agaricus flocculosus</i> DC.:Fr. 1815		
<i>floridulus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	94	[124]
<i>flux</i> , <i>Lentinus</i> ? [(G.Mey.:Fr.) Fr. 1825]	393	[-]
= <i>Agaricus flos</i> G.Mey.:Fr. 1818		
<i>fluminensis</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Mont. 1834]	201	[-]
<i>fluxilis</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr.:Fr. 1821]	137	[180]
<i>focalis</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Fr. 1838, sp. nov.]	20	[40]
<i>foeniculaceus</i> , <i>Marasmius</i> [Fr. 1836]	374	[466]
= <i>Agaricus peronatus</i> β <i>tomentellus</i> Lasch 1828, nom. illegit., non (Schumach.:Fr.) Fr. 1821		
<i>foenisecii</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Pers.:Fr. 1800]	227	[303]
<i>foetens</i> , <i>Panus</i> [Fr. 1838, sp. nov.]	399	[489]
= <i>Agaricus dimidiatus</i> Secr. 1833, nom. inval.		
<i>foetens</i> , <i>Russula</i> [Pers.:Fr. 1796]	359	[447]
= <i>Agaricus Russula foetens</i> (Pers.:Fr.) Pers. 1801		
<i>foetidus</i> , <i>Marasmius</i> [(Sowerby:Fr.) Fr. 1838, comb. nov.] . . .	380	[473]
= <i>Merulius foetidus</i> Sowerby:Fr. 1796–97		
= <i>Agaricus foetidus</i> (Sowerby:Fr.) Fr. 1821		
<i>formosus</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Fr.:Fr. 1821]	154	[204]
<i>fornicatus</i> , <i>Hygrophorus</i> [Fr. 1838, sp. nov.]	327	[414]
<i>fracidus</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Fr. 1838, sp. nov.]	25	[47]
<i>fragilis</i> , <i>Bolbitius</i> [(L.) Fr. 1838, comb. nov.]	254	[334]
= <i>Agaricus fragilis</i> L. 1753, non Batsch:Fr. 1789, nec Pers.:Fr. 1801		
<i>fragilis</i> , <i>Russula</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	359	[450]
= <i>Agaricus Russula fragilis</i> Pers.:Fr. 1801, non <i>Agaricus fragilis</i> L. 1753, nec Batsch:Fr. 1789		
<i>fragrans</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [With.:Fr. 1792]	78	[105]
<i>friabilis</i> , <i>Lentinus</i> [Fr. 1836]	394	[485]
<i>friesii</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Lasch:Fr. 1828]	14	[31]
<i>fritilliformis</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Lasch 1838, sp. nov.] . . .	74	[101]
<i>frumentaceus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Bull. ex DC.:Fr. 1805] . .	30	[52]
<i>frustulentus</i> , <i>Agaricus</i> (<i>Galera</i>) [Fr. 1838, sp. nov.]	209	[307]
<i>fucatophyllus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>)		
[(Lasch:Fr.) Fr. 1838, comb. nov.]	289	[372]
= <i>Agaricus fucatophyllus</i> Lasch:Fr. 1828		
<i>fucatus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1821]	27	[49]
<i>fulgens</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.] . . .	267	[347]
= <i>Agaricus fulgens</i> sensu Alb. & Schwein. 1805, non Pers.:Fr. 1800		
<i>fuliginarius</i> , <i>Agaricus</i> (<i>Collybia</i>) [Batsch 1783]	96	[127]
<i>fuliginosus</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	348	[434]
= <i>Agaricus fuliginosus</i> Fr.:Fr. 1821		
<i>fulmineus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) <i>fulgens</i> var.		
[Fr. 1838, nom. nov.]	267	[347 as <i>Cortinarius fulmineus</i>]
= <i>Agaricus sericeus</i> Schaeff. 1774		
= <i>Agaricus fulgens</i> Pers. 1800		
= <i>Agaricus bivelus</i> β <i>fulgens</i> (Pers.:Fr.) Fr. 1821		

Taxon	Page	[Hym. Eur. page]
<i>fulvellus</i> , <i>Agaricus</i> (<i>Psalliota</i>) <i>spodophyllus</i> var. [Fr. 1838, var. nov.] 214	[279 as <i>Agaricus pratenensis</i> * <i>fulveolus</i> (sic)]	
= <i>Agaricus fulvodenticulatus</i> Lasch 1829		
<i>fulvellus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) <i>nictitans</i> var. [Fr. 1838, var. nov.] 28	[50]	
= <i>Agaricus fulvus</i> Bull.:Fr. 1792		
<i>fulvescens</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.] . . . 311	[395]	
= <i>Agaricus ochrofulvescens</i> Secr. 1833, nom. inval.		
<i>fumosus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Pers.:Fr. 1801] 56	[91]	
<i>furcata</i> [sic], <i>Lenzites</i> – See <i>furcatus</i> , <i>Lenzites</i>		
<i>furcata</i> , <i>Russula</i> [(Lam.:Fr.) Pers. 1796] 352	[441]	
= <i>Amanita furcata</i> Lam.:Fr. 1783		
= <i>Agaricus furcatus</i> (Lam.:Fr.) Hoffm. 1789		
<i>furcatus</i> , <i>Lenzites</i> [(Link ex Fr.:Fr.) Fr. 1838, comb. nov., ‘ <i>furcata</i> ’] 404	[–]	
= <i>Daedalea furcata</i> Link ex Fr.:Fr. 1830		
<i>furfuraceus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Pers.:Fr. 1801] 200	[272]	
<i>furfurosus</i> , <i>Lentinus</i> (<i>Scleroma</i>) [Fr. 1838, nom. nov.] 391	[–]	
= <i>Agaricus omphalomorphus</i> Bertero & Mont. 1837		
<i>furvus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1818] 33	[57]	
= <i>Agaricus phaiiocephalus</i> β <i>furvus</i> (Fr.:Fr.) Fr. 1821		
<i>fuscescens</i> , <i>Coprinus</i> [(Schaeff.) Fr. 1838, comb. nov.] 244	[322]	
= <i>Agaricus fuscescens</i> Schaeff. 1774		
<i>fuscoalbus</i> , <i>Hygrophorus</i> [(Lasch:Fr.) Fr. 1838, comb. nov.] . . 324	[410]	
= <i>Agaricus fuscoalbus</i> Lasch:Fr. 1829		
<i>fuscopallens</i> , <i>Cortinarius</i> (<i>Telamonia</i>) <i>triformis</i> var. [Fr. 1838, var. nov.] 299	[383]	
<i>fuscopurpureus</i> , <i>Marasmius</i> [(Pers.:Fr.) Fr. 1838, comb. nov.] . 377	[469]	
= <i>Agaricus fuscopurpureus</i> Pers.:Fr. 1798		
<i>fusiformis</i> , <i>Agaricus</i> (<i>Tricholoma</i>) <i>saponaceus</i> var. [(Schumach.) Fr. 1838, comb. nov.] 36	[59 sub <i>Agaricus saponaceus</i>]	
= <i>Agaricus fusiformis</i> Schumach. 1803		
<i>fusipes</i> , <i>Agaricus</i> (<i>Collybia</i>) [Bull.:Fr. 1782–83] 83	[111]	
<i>fusus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Batsch 1789] 186	[247]	

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<i>galbanus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Lasch:Fr. 1829] 41	[168 sub <i>Agaricus decorus</i>]
<i>Galera</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821] 203, 599	[6, 266]
<i>galericulatus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Scop.:Fr. 1772] 106	[138]
= <i>Mycena galericulata</i> (Scop.:Fr.) Gray 1821	
<i>gallinaceus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Scop. 1772] 63	[88]
<i>galochroa</i> , <i>Russula heterophylla</i> var. [(Fr.) Fr. 1838, comb. nov.] 353	[447]
= <i>Agaricus galochroa</i> Fr. 1815	

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<i>galopus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Pers.:Fr. 1800]	115	[149]
<i>gambosus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1821]	43	[66]
<i>gangraenosus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1838, sp. nov.]	56	[80]
<i>garidelli</i> [sic], <i>Agaricus</i> – See <i>garidellii</i> , <i>Agaricus</i>		
<i>garidellii</i> [<i>'garidelli'</i>], <i>Agaricus</i> (<i>Clitocybe</i>) [(Paulet) Fr. 1836] . .	71	[98 ' <i>garidelli</i> ']
= <i>Hypophyllum garidellii</i> Paulet ?1793		
<i>gausapatus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1821]	34	[57]
<i>geminus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [(Paulet) Fr. 1838, comb. nov.]	38	[61]
= <i>Hypophyllum geminum</i> Paulet ?1793		
<i>gemmaus</i> , <i>Agaricus</i> (<i>Amanita</i>) [Fr. 1838, sp. nov.]	12	[28]
<i>gentilis</i> , <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	297	[380]
= <i>Agaricus helvolus</i> Pers. 1801, nom. illegit., non Schaeff. 1774		
= <i>Agaricus gentilis</i> Fr.:Fr. 1821		
<i>geogenius</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [DC. ex Fr. 1838, sp. nov.] . .	134	[175]
<i>geophyllus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Sowerby:Fr. 1798–99]	176	[235]
<i>georgii</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [L. 1753]	43	[67]
<i>geotropus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Bull. ex DC. 1805]	70	[96]
<i>germanus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.] . . .	312	[397]
<i>gibberosus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr. 1838, sp. nov.] 163, 215	[521]	[217]
<i>giganteus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Sibth.:Fr. 1794]	67	[401 as <i>Paxillus giganteus</i>]
<i>gilvus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Pers.:Fr. 1801]	70	[95]
<i>glandicolor</i> , <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Fr.) Fr. 1838, comb. nov.]	298	[382]
= <i>Agaricus gentilis</i> β <i>glandicolor</i> Fr.:Fr. 1821		
<i>glandifer</i> , [†] <i>Agaricus</i> [Pers. 1801]	325	[412 sub
<i>Hygrophorus caprinus</i>]		
<i>glandulosus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Bull.:Fr. 1789]	133	[174 as <i>Agaricus ostreatus</i> * <i>glandulosus</i>]
<i>glaucinitens</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1821]	54	[421 as <i>Hygrophorus nitratus</i> * <i>glaucinitens</i>]
= <i>Agaricus nitens</i> Batsch:Fr. 1789		
<i>glaucophyllus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Lasch:Fr. 1828]	123	[159]
<i>glaucopus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Schaeff.:Fr.) Fr. 1838, comb. nov.]	264	[344]
= <i>Agaricus glaucopus</i> Schaeff.:Fr. 1774		
<i>glaucus</i> , <i>Cantharellus</i> [(Batsch) Fr. 1838, comb. nov.]	368	[460]
= <i>Agaricus glaucus</i> Batsch 1786		
<i>globularis</i> , <i>Agaricus</i> (<i>Collybia</i>) [Weinm. 1835]	89	[115]
<i>gloiocephalus</i> [<i>'glojocephalus'</i>], <i>Agaricus</i> (<i>Volvaria</i>)		
[DC.:Fr. 1815]	140	[183 " <i>glojocephalus</i> "]
<i>glojocephalus</i> [sic], <i>Agaricus</i> – See <i>gloiocephalus</i> , <i>Agaricus</i>		
<i>glutiniifer</i> , <i>Hygrophorus</i> [Fr. 1838, nom. nov.]	322	[407]
= <i>Agaricus glutinosus</i> Bull. 1786, nom. illegit., non Schaeff.:Fr. 1774		
<i>glutinosus</i> , <i>Gomphidius</i> [(Schaeff.:Fr.) Fr. 1838, comb. nov.] . .	319	[399]
= <i>Agaricus glutinosus</i> Schaeff.:Fr. 1774		

Taxon	Page	[Hym. Eur. page]
<i>glyciosmus</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr.1838, comb. nov.]	348	[434]
= <i>Agaricus glyciosmus</i> Fr.:Fr. 1818		
<i>Gomphidius</i> [Fr. 1836]	319, 601	[8, 399]
<i>gomphodes</i> , † <i>Agaricus</i> (<i>Panaeolus</i>) [Fr. 1838, sp. nov.]	237	[313]
<i>gorteri</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Weinm. 1832]	153	[204]
<i>gossypinus</i> , <i>Agaricus</i> (<i>Psathyra</i>) [Bull.:Fr. 1789]	234	[309]
<i>gracilentus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Krombh. 1836]	13	[30]
<i>gracilis</i> , <i>Agaricus</i> (<i>Psathyrella</i>) [Fr.:Fr. 1821]	238	[313]
<i>gracillimus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Weinm. 1836]	128	[165]
nom. illegit., non <i>Agaricus gracillimus</i> Weinm. 1826		
<i>grallipes</i> , <i>Cortinarius</i> (<i>Myxacium</i>) [Fr. 1838, sp. nov.]	275	[355]
= <i>Agaricus helvolus</i> sensu Sw. 1808, non Pers. 1801		
<i>graminicola</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Nees:Fr. 1816–17]	202	[265]
<i>grammopodius</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Bull.:Fr. 1792]	50	[74]
<i>granulosus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Batsch:Fr. 1783]	17	[36]
= <i>Lepiota granulosa</i> (Batsch:Fr.) Gray 1821		
<i>gratus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Weinm. 1836]	175	[233]
<i>graveolens</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Pers.:Fr. 1801]	44	[67]
<i>grisea</i> , <i>Russula</i> [Fr. 1838, nom. nov.]	361	[451]
= <i>Agaricus Russula griseus</i> Pers. 1801, nom. illegit., non <i>Agaricus griseus</i> Batsch 1786, nec Fr.:Fr. 1815		
<i>griseocyaneus</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Fr.:Fr. 1821]	145	[193]
<i>griseofuscus</i> , <i>Agaricus</i> (<i>Armillaria</i>) [DC.:Fr. 1815]	24	[45]
<i>griseopallidus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Desm.:Fr. 1826]	125	[161]
<i>griseorubellus</i> , <i>Agaricus</i> (<i>Eccilia</i>) [Lasch:Fr. 1829]	159	[212]
<i>griseotomentosus</i> , <i>Paxillus</i> [Secr. ex Fr. 1838, sp. nov.]	318	[404]
= <i>Agaricus griseotomentosus</i> Secr. 1833, nom. inval.		
<i>griseus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr.:Fr. 1815]	127	[164]
<i>grumatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Scop. 1772]	80[bis]	[108]
<i>gummosus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Lasch:Fr. 1828]	185	[247]
<i>gunneri</i> , † <i>Agaricus</i> (<i>Psalliota</i>) [Fr.:Fr. 1821]	217	[–]
= <i>Agaricus echinatus</i> Gunn. 1772, non Roth:Fr. 1800		
<i>guttatus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Schaeff. 1774]	31	[54]
unavailable name, non <i>Agaricus guttatus</i> Pers.:Fr. 1793		
<i>gymnopodius</i> , <i>Agaricus</i> (<i>Flammula</i>) [Bull. ex Pers.:Fr. 1801]	183	[244]
<i>gypseus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr. 1838, sp. nov.]	104	[135]
= <i>Agaricus fistulosus</i> Bull. 1791, pro parte		
<i>gyrans</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [(Paulet) Fr. 1838, comb. nov.]	79	[106]
= <i>Hypophyllum gyrans</i> Paulet ?1793		
<i>gyroflexus</i> , <i>Agaricus</i> (<i>Psathyra</i>) [Fr. 1838, nom. nov.]	232	[305]
= <i>Agaricus pallescens</i> Schaeff. 1774		

H

<i>haematocephalus</i> , <i>Marasmius</i> [(Mont.) Fr. 1838, comb. nov.]	382	[–]
= <i>Agaricus haematocephalus</i> Mont. 1837		

Taxon	Page	[Hym. Eur. page]
<i>haematochelis</i> , † <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Bull.) Fr. 1838, comb. nov.]	302	[378]
= <i>Agaricus haematochelis</i> Bull. 1791		
<i>haematopus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Pers.:Fr. 1800]	114	[148]
<i>haematospermus</i> , <i>Agaricus</i> (<i>Psalliota</i>)		
[Bull. ex Pers.:Fr. 1801]	215 ['521']	[282]
<i>hariolorum</i> , <i>Agaricus</i> (<i>Collybia</i>) [Bull.:Fr. 1781–82]	.88	[117]
<i>harmoge</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr. 1838, nom. nov.]	189	[251]
= <i>Agaricus fulvomarginatus</i> Weinm. 1836		
<i>haustellaris</i> , <i>Agaricus</i> (<i>Crepidotus</i>) [Fr.:Fr. 1818]	211	[276]
<i>Hebeloma</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	170, 599	[6, 237]
<i>hepedodius</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1821]	.66	[92]
<i>hebes</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [(Fr.) Fr. 1838, comb. nov.]	227	[303]
= <i>Agaricus obtusatus</i> β <i>hebes</i> Fr.:Fr. 1821		
<i>helomorphus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr. 1838, sp. nov.]	184	[252]
<i>helvelloides</i> , <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Fr.) Fr. 1838, comb. nov.]	297	[380]
= <i>Agaricus gentilis</i> ε <i>helvelloides</i> Fr.:Fr. 1821		
<i>helvolus</i> , <i>Cortinarius</i> (<i>Telamonia</i>) [Fr. 1838, nom. nov.]	296	[379]
= <i>Agaricus helvolus</i> Bull. 1792, 'helveolus', nom. illegit., non Schaeff. 1774		
<i>helvus</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	347	[433]
= <i>Agaricus helvus</i> Fr.:Fr. 1821		
<i>hemerobius</i> , <i>Coprinus</i> [Fr. 1838, nom. nov.]	253	[332]
= <i>Agaricus campanulatus</i> Bolton 1788, nom. illegit., non L. 1753, nec Bull.:Fr. 1792		
<i>hemitrichus</i> , <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Pers.:Fr.) Fr. 1838, comb. nov.]	302	[385]
= <i>Agaricus hemitrichus</i> Pers.:Fr. 1801		
<i>hendersonii</i> , <i>Coprinus</i> [(Berk.) Fr. 1838, comb. nov.]	250	[329]
= <i>Agaricus hendersonii</i> Berk. 1836		
<i>hepaticus</i> , <i>Agaricus</i> (<i>Omphalia</i>) <i>pyxidatus</i> var.		
[Fr. 1838, var. nov.]	122	[160 as <i>Agaricus</i>
= <i>Agaricus subhepaticus</i> Batsch 1789	.hepaticus]	
= <i>Agaricus hepaticus</i> Fr. 1815, nom. illegit., non Batsch 1783		
<i>herpeticus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.]	268	[349]
<i>heteroclitus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr. 1818]	165	[220]
= <i>Agaricus aurivellus</i> β <i>A. heteroclitus</i> (Fr.:Fr.) Fr. 1821		
heteromorpha [sic], Lenzites – See <i>heteromorphus</i> , <i>Lenzites</i>		
<i>heteromorphus</i> , <i>Lenzites</i> [Fr. 1838, nom. nov., 'heteromorpha']	407	[495 'heteromorpha']
= <i>Daedalea heteromorpha</i> α <i>nodulosa</i> Fr.:Fr. 1828		
[= <i>Daedalea heteromorpha</i> sensu Fr. 1821, pro parte]		
non <i>Daedalea heteromorpha</i> Fr.:Fr. 1815		
[= <i>Daedalea heteromorpha</i> β <i>interrupta</i> Fr.:Fr. 1828]		
<i>heterophylla</i> , <i>Russula</i> [(Fr.) Fr. 1838, comb. nov.]	352	[446]
= <i>Agaricus furcatus</i> β <i>heterophyllus</i> Fr.:Fr. 1821		
<i>heterostichus</i> , <i>Agaricus</i> (<i>Naucoria</i>) <i>furfuraceus</i> var. [Fr. 1818]	200	[273]
<i>hiascens</i> , <i>Agaricus</i> (<i>Psathyrella</i>) [Fr.:Fr. 1821]	238	[314]

Taxon	Page	[Hym. Eur. page]
<i>hiemalis</i> , <i>Agaricus</i> (<i>Mycena</i>) [Osbeck 1805]	119	[153]
<i>hilarianus</i> , <i>Agaricus</i> (<i>Galera</i>) [Mont. 1837]	203	[-]
<i>hilaris</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1821]	192	[254]
<i>hinnuleus</i>, <i>Cortinarius</i> (<i>Telamonia</i>)		
[(With.) Fr. 1838, comb. nov.]	296	[380]
= <i>Agaricus hinnuleus</i> With. 1792		
<i>hircinus</i>, <i>Cortinarius</i> (<i>Inoloma</i>) [Fr. 1838, sp. nov.]	280	[362]
= <i>Agaricus violaceus</i> sensu Bolton 1788, non L.:Fr. 1753, nec Schaeff. 1774		
<i>hirneolus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1818]	58	[82]
<i>hirsutus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Lasch:Fr. 1829]	171	[227]
<i>hirtellus</i>, <i>Coprinus</i> [Fr. 1838, sp. nov.]	247	[(328)]
<i>hirtipes</i> , <i>Agaricus</i> (<i>Nolanea</i>) [Schumach.:Fr. 1803]	158	[209]
<i>hirtus</i>, <i>Panus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	398	[-]
= <i>Agaricus hirtus</i> Fr.:Fr. 1830		
<i>hispidosus</i>, <i>Lentinus</i> [Fr. 1838, nom. nov.]	389	[485]
= <i>Agaricus coriaceus</i> Scop. 1772		
<i>hispidulus</i> , <i>Agaricus</i> (<i>Pluteus</i>) [Fr.:Fr. 1818]	141	[187]
<i>hispidus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Lasch 1829]	14	[32]
<i>hiulcus</i>, <i>Agaricus</i> (<i>Hebeloma</i>) [Fr. 1838, sp. nov.]	175	[232]
<i>hoeftii</i>, <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Weinm.) Fr. 1838, comb. nov.]	306	[389]
= <i>Agaricus hoeftii</i> Weinm. 1836		
<i>holosericeus</i>, <i>Agaricus</i> (<i>Lepiota</i>) [Fr. 1838, sp. nov.]	16	[34]
<i>hordus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1821]	39	[62]
<i>horizontalis</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Bull.:Fr. 1787–88]	194	[256]
<i>hornemannii</i> ['hornemanni'], <i>Agaricus</i> (<i>Psalliota</i>)		
[Fr.:Fr. 1818]	218	[283 'hornemannii', sub <i>Agaricus depilatus</i>]
<i>hornotinus</i> , <i>Lentinus</i> [Fr. 1836]	391	[483]
<i>hortensis</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Pers.:Fr. 1801]	65	[90]
<i>hudsoni</i> [sic], <i>Marasmius</i> – See <i>hudsonii</i> , <i>Marasmius</i>		
<i>hudsonii</i>, <i>Marasmius</i> [(Pers.:Fr.) Fr. 1838, comb. nov., 'hudsoni']	386	[478 'hudsoni']
= <i>Agaricus hudsonii</i> Pers.:Fr. 1801		
= <i>Mycena hudsonii</i> (Pers.:Fr.) Gray 1821		
<i>humilis</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Pers.:Fr. 1801]	52	[75]
<i>humosus</i>, <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1838, sp. nov.]	66	[92]
<i>hybridus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Sowerby 1798–99]	189	[250]
= <i>Agaricus sapineus</i> β <i>A. hybridus</i> (Sowerby:Fr.) Fr. 1821		
<i>Hydrocybe</i>, <i>Cortinarius</i> “trib.”		
[Fr. 1838, “trib.” nov.]	303, (601 'Hygrocybe')	[8, 386]
<i>hydrogrammus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Bull.:Fr. 1792]	120	[154]
<i>hydrophilus</i> , <i>Agaricus</i> (<i>Hypholoma</i>) [Bull. 1791]	225	[333 as <i>Bolbitius</i> <i>hydrophilus</i>]
<i>hydrophilus</i>, <i>Agaricus</i> (<i>Psilocybe</i>) <i>spadiceus</i> var.		
[(Fr.:Fr.) Fr. 1838, comb. nov., 'hygrophitus']	226	[302 'hygrophilus']
= <i>Agaricus stipatus</i> β <i>A. hydrophilus</i> Fr.:Fr. 1821		

Taxon	Page	[Hym. Eur. page]
<i>hydrophorus</i> , <i>Agaricus</i> (<i>Psathyrella</i>) [Bull.:Fr. 1792–93]	238	[314]
Hygrocybe [sic], Cortinarius “trib.” – See <i>Hydrocybe</i> , <i>Cortinarius</i> “trib.”		
hygrophitus [sic], <i>Agaricus</i> <i>spadiceus</i> – See <i>hydrophilus</i> , <i>Agaricus</i> <i>spadiceus</i>		
<i>Hygrophorus</i> [Fr. 1836]	320, 601	[8, 405]
<i>hyperellus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1828]	195	[257]
<i>Hypholoma</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	221, 599	[7, 290]
<i>hypnorum</i> , <i>Agaricus</i> (<i>Galera</i>) [Schrank:Fr. 1789]	207	[270]
<i>hypomelas</i> , [†] <i>Agaricus</i> (<i>Panaeolus</i>) [Fr. 1838, sp. nov.]	237	[313]
<i>hypothejus</i> , <i>Hygrophorus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	324	[410]
= <i>Agaricus hypothejus</i> Fr.:Fr. 1818		
<i>hypsipus</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Fr. 1838, sp. nov.]	218	[290]
<i>hysginus</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	337	[426]
= <i>Agaricus hysginus</i> Fr.:Fr. 1818		
<i>hystrix</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr. 1838, sp. nov.]	171	[227]
I		
<i>ianthinus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1821]	112	[145]
<i>ianthipes</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[Secr. ex Fr. 1838, sp. nov., ‘ <i>ianthipes</i> ’]	313	[397]
= <i>Agaricus ianthipes</i> Secr. 1833, nom. inval.		
<i>ichoratus</i> , <i>Lactarius</i> [(Batsch) Fr. 1838, comb. nov.]	345	[436]
= <i>Agaricus ichoratus</i> Batsch 1786		
<i>icterinus</i> , <i>Agaricus</i> (<i>Nolanea</i>) [Fr.:Fr. 1821]	157	[209]
<i>ileopodius</i> , <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Bull.) Fr. 1838, comb. nov., ‘ <i>ileopodius</i> ’]	301	[385 ‘ <i>ileopodius</i> ’]
= <i>Agaricus ileopodius</i> Bull.:Fr. 1793		
<i>ilicinus</i> , <i>Agaricus</i> (<i>Flammula</i>) [DC.:Fr. 1815]	191	[112 sub <i>Agaricus fusipes</i>]
<i>iliopodius</i> [sic], <i>Cortinarius</i> – See <i>ileopodius</i> , <i>Cortinarius</i>		
<i>illibatus</i> , <i>Cortinarius</i> (<i>Myxaciium</i>) [Fr. 1838, sp. nov.]	276	[358]
<i>illinitus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Fr.:Fr. 1818]	19	[39]
<i>illudens</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Schwein.:Fr. 1822]	66	[–]
<i>illuminus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.]	305	[388]
<i>imbricatus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1815]	33	[56]
<i>imbutus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.]	306	[390]
<i>impatiens</i> , <i>Agaricus</i> (<i>Psathyrella</i>) [Fr.:Fr. 1821]	238	[313]
<i>impennis</i> , <i>Cortinarius</i> (<i>Telamonia</i>) [Fr. 1838, sp. nov.]	293	[376]
<i>impolitus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Lasch:Fr. 1829]	32	[55]
<i>impudicus</i> , <i>Marasmius</i> [Fr. 1838, sp. nov.]	377	[471]
<i>inaequalis</i> , [†] <i>Agaricus</i> [Weinm. 1836]	310	[394]
<i>inamoenus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1815]	40	[64]
<i>incanus</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Fr.:Fr. 1821]	154	[204]
<i>incilis</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1838, sp. nov.]	69	[94]
<i>incisus</i> , <i>Cortinarius</i> (<i>Telamonia</i>) [(Pers.) Fr. 1838, comb. nov.]	301	[384]
= <i>Agaricus incisus</i> Pers. 1801		
= <i>Agaricus gentilis</i> δ <i>incisus</i> (Pers.:Fr.) Fr. 1821		

Taxon	Page	[Hym. Eur. page]
<i>inclinatus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr. 1838, nom. nov.]	107	[139]
= <i>Hypophyllum spadiceum</i> Paulet ?1793		
<i>incomtus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1818]	.80	[106]
<i>incurvus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>)		
[(Pers.) Fr. 1838, comb. nov.]	286	[369 sub <i>Cortinarius albocyaneus</i>]
= <i>Agaricus incurvus</i> Pers. 1798		
= <i>Agaricus anomalus</i> β <i>incurvus</i> (Pers.:Fr.) Fr. 1821		
<i>indigo</i> , <i>Lactarius</i> [(Schwein.:Fr.) Fr. 1838, comb. nov.]	341	[-]
= <i>Agaricus indigo</i> Schwein.:Fr. 1822		
<i>infractus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.] . .	261	[341]
= <i>Agaricus infractus</i> Pers.:Fr. 1800, pro parte		
= <i>Agaricus infractus</i> sensu Alb. & Schwein. 1805		
<i>infula</i> , <i>Agaricus</i> (<i>Nolanea</i>) [Fr. 1836]	158	[209]
<i>infundibuliformis</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Schaeff. 1774]	.68	[93]
= <i>Agaricus flaccidus</i> Sowerby:Fr. 1798–99 [fide Fries 1821, p. 81]		
= <i>Agaricus gibbus</i> Pers.:Fr. 1801 [var. α] [fide Fries-1828, <i>Elenchus Fungorum</i> 1: 12]		
<i>infundibuliformis</i> , <i>Cantharellus</i> [(Scop.) Fr. 1838, comb. nov.]	366	[458]
= <i>Merulius infundibuliformis</i> Scop. 1772		
<i>ingratus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Schumach.:Fr. 1803]	.88	[118]
<i>injucundus</i> , <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Weinm.) Fr. 1838, comb. nov.]	298	[381]
= <i>Agaricus injucundus</i> Weinm. 1836		
<i>innocuus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Lasch:Fr. 1828]	194	[257]
<i>inoculatus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Fr. 1838, sp. nov.]	.19	[39]
<i>inodorus</i> , [†] <i>Agaricus</i> [Bull. 1791]	312	[194 sub <i>Agaricus sericellus</i>]
<i>inolens</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	.96	[126]
= <i>Agaricus zephirus</i> sensu Weinm. 1836, non Fr.:Fr. 1818		
<i>Inoloma</i> , <i>Cortinarius</i> “trib.” [(Fr.:Fr.) Fr. 1838, comb. nov.]	278, 600	[8, 359]
= <i>Agaricus trib.</i> <i>Inoloma</i> Fr.:Fr. 1821		
<i>inopus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr.:Fr. 1818]	187	[249]
<i>inornatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Sowerby:Fr. 1800–03]	.57	[80]
<i>inquilinus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1818]	199	[274]
<i>insititius</i> , <i>Marasmius</i> [Fr. 1838, sp. nov.]	.386	[478]
<i>insulsus</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	336	[424]
= <i>Agaricus insulsus</i> Fr.:Fr. 1821		
<i>integra</i> , <i>Russula</i> [(L.) Fr. 1838, comb. nov.]	360	[450]
= <i>Agaricus integer</i> L. 1753		
<i>integrellus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Pers.:Fr. 1800]	128	[165]
= <i>Mycena integrella</i> (Pers.:Fr.) Gray 1821		
<i>intentus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.] . . .	272	[352]
<i>interrupta</i> [sic], <i>Lenzites</i> – See <i>interruptus</i> , <i>Lenzites</i>		
<i>interruptus</i> , <i>Lenzites</i> [(Fr.:Fr.) Fr. 1838, comb. nov., ‘ <i>interrupta</i> ’]	405	[-]
= <i>Daedalea interrupta</i> Fr.:Fr. 1830		
<i>inunctus</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Fr.:Fr. 1828]	219	[284]
<i>inversus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Scop. 1772]	.70	[96]

Taxon	Page	[Hym. Eur. page]
<i>involutus</i> , <i>Paxillus</i> [(Batsch:Fr.) Fr. 1838, comb. nov.]	317	[403]
= <i>Agaricus involutus</i> Batsch:Fr. 1786		
<i>ionides</i> ['jonides'], <i>Agaricus</i> (<i>Tricholoma</i>) [Bull.:Fr. 1792]	41	[65]
<i>irinus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	48	[72]
= <i>Agaricus personatus</i> β <i>A. cyclophilus</i> Lasch 1828		
<i>iris</i> , [†] <i>Agaricus</i> (<i>Mycena</i>) [Berk. 1836]	102	[131]
<i>irregularis</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Bolton) Fr. 1838, comb. nov.]	310	[394]
= <i>Agaricus irregularis</i> Bolton 1788		
<i>irrigatus</i> , <i>Hygrophorus</i>		
[(Pers.:Fr.) Fr. 1838, comb. nov., 'irriguus']	329	[416]
= <i>Agaricus irrigatus</i> Pers.:Fr. 1801		
irriguus [sic], <i>Hygrophorus</i> – See <i>irrigatus</i> , <i>Hygrophorus</i>		
<i>isabellinus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, nom. nov.] . .	308	[392]
= <i>Agaricus ochraceus</i> Batsch 1783, nom. illegit., non Schaeff. 1774		
non <i>Agaricus spadiceus</i> Batsch 1783		
[Fries's citation (1838, p. 308) of 'Batsch f. 16' [i.e. <i>Agaricus spadiceus</i>] is a lapsus calami,		
later corrected to 'Batsch f. 17' (Fries 1874, p. 392). Elsewhere (Fries 1838, p. 261) he cited		
'Batsch f. 16' correctly as the basionym of <i>Cortinarius spadiceus</i> .]		
iuncicola [sic], <i>Agaricus</i> – See <i>juncicola</i> , <i>Agaricus</i>		

J

janthipes [sic], <i>Cortinarius</i> – See <i>ianthipes</i> , <i>Cortinarius</i>		
<i>jasmineus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[Secr. ex Fr. 1838, sp. nov.]	262	[342]
= <i>Agaricus jasmineus</i> Secr. 1833, nom. inval.		
<i>jecorinus</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	344	[433]
= <i>Agaricus jecorinus</i> Fr.:Fr. 1821		
jonides [sic], <i>Agaricus</i> – See <i>ionides</i> , <i>Agaricus</i>		
<i>jubarinus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, nom. nov.] . .	309	[393]
= <i>Agaricus araneosus</i> var. <i>nitidus</i> Bull. 1789		
<i>jubatus</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Fr.:Fr. 1821]	145	[193]
<i>jugis</i> , <i>Lentinus</i> [(Fr.:Fr.) Fr. 1832]	393	[484]
= <i>Agaricus jugis</i> Fr.:Fr. 1821		
<i>junceus</i> , <i>Agaricus</i> (<i>Nolanea</i>) [Fr.:Fr. 1821]	156	[207]
<i>juncicola</i> ['iuncicola'], <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1821]	119	[154]
<i>junghuhnii</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[Fr. 1838, sp. nov., 'junghunii?']	314	[398]
junghunii [sic], <i>Cortinarius</i> – See <i>junghuhnii</i> , <i>Cortinarius</i>		
<i>junonius</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr.:Fr. 1821]	167	[223]

K

<i>koenigii</i> , <i>Trogia</i> [Fr. 1838, sp. nov., 'königii']	402	[-]
königii [sic], <i>Trogia</i> – See <i>koenigii</i> , <i>Trogia</i>		
<i>krombholzii</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.] . .	311	[395]
= <i>Agaricus leucopus</i> sensu Krombh. 1831, non Pers.:Fr. 1801		

Taxon	Page	[Hym. Eur. page]
L		
<i>laccatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Scop.:Fr. 1772]	79[bis]	[108]
<i>laceratus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Lasch ex Fr. 1838, sp. nov.]	97	[127]
nom. illegit., non <i>Agaricus laceratus</i> Scop. 1772, nec Bolton 1788		
<i>lacerus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr.:Fr. 1821]	173	[229]
<i>lachnopus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) <i>fimbriatus</i> var.		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	131	[169]
≡ <i>Agaricus lachnopus</i> Fr. 1815		
≡ <i>Agaricus lignatilis</i> β <i>A. lachnopus</i> (Fr.:Fr.) Fr. 1821		
<i>lacmus</i> , <i>Hygrophorus subradiatus</i> var.		
[(Schumach.) Fr. 1838, comb. nov.]	329	[416]
≡ <i>Agaricus lacmus</i> Schumach. 1803		
<i>lacrymabundus</i> , <i>Agaricus</i> (<i>Hypholoma</i>) [Bull.:Fr. 1785]	223	[293]
<i>Lactarius</i> [Pers. 1797]	333, 601	[9, 421]
<i>lactea</i> , <i>Russula</i> [(Pers.) Fr. 1838, comb. nov.]	355	[443]
≡ <i>Agaricus Russula lacteus</i> Pers. 1801, p. 439, non <i>Agaricus lacteus</i> Pers.:Fr. 1801, p. 394		
<i>lacteus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Pers.:Fr. 1801, p. 394]	103	[135]
<i>lacunosus</i> , † <i>Coprinus</i> [(Pers.) Fr. 1838, comb. nov.]	249	[(328)]
≡ <i>Agaricus Coprinus lacunosus</i> Pers. 1801		
<i>lacunosus</i> , [†] <i>Paxillus</i> [Fr. 1838, sp. nov.]	318	[-]
<i>laetus</i> , <i>Hygrophorus</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	329	[417]
≡ <i>Agaricus laetus</i> Pers.:Fr. 1800		
<i>laevigatus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Lasch:Fr. 1828]	108	[140]
<i>lagopus</i> , <i>Coprinus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	250	[329]
≡ <i>Agaricus lagopus</i> Fr.:Fr. 1821		
<i>lampropus</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Fr.:Fr. 1815]	152	[202]
<i>lanatus</i> , <i>Coprinus</i> [Fr. 1838, nom. nov.]	251	[330]
≡ <i>Agaricus lanatus</i> Bong. ex Weinm. 1836, nom. illegit., non Schumach. 1803, nec Sowerby 1809–14		
<i>lancipes</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	83	[112]
<i>languidus</i> , <i>Marasmius</i> [(Lasch) Fr. 1838, comb. nov.]	379	[473]
≡ <i>Agaricus languidis</i> Lasch 1828		
<i>laniger</i> , <i>Cortinarius</i> (<i>Telamonina</i>) [Fr. 1838, sp. nov.]	292	[375]
<i>lanuginosus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Bull.:Fr. 1788]	171	[227]
<i>lappula</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Fr. 1838, sp. nov.]	152	[202]
<i>laqueatus</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Fr. 1838, sp. nov.]	24	[46]
<i>largus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.]	259	[339]
<i>laricinus</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Bolton 1788]	23	[44 as <i>Agaricus melleus</i> * <i>laricinus</i>]
<i>laschii</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Fr. 1838, sp. nov.]	22	[43]
<i>lascivus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1821]	40	[64]
<i>lateripes</i> , <i>Lactarius</i> [(Desm.) Fr. 1838, comb. nov.]	349	[438]
≡ <i>Agaricus lateripes</i> Desm. 1823		
<i>lateritius</i> , <i>Agaricus</i> (<i>Galera</i>) [Fr.:Fr. 1821]	204	[267]
nom. illegit., non <i>Agaricus lateritius</i> Schaeff.:Fr. 1774		

Taxon	Page	[Hym. Eur. page]
<i>latus</i>, <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Pers.:Fr.) Fr. 1838, comb. nov.]	260	[340]
= <i>Agaricus latus</i> Pers.:Fr. 1801		
<i>laxipes</i>, <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	86	[115]
<i>lazulinus</i>, <i>Agaricus</i> (<i>Leptonia</i>) [Fr. 1838, nom. nov.]	153	[203]
= <i>Agaricus glaucus</i> Bull. 1791, nom. illegit., non Batsch 1786		
<i>leccinus</i>, <i>Agaricus</i> (<i>Amanita</i>) [Scop. 1772]	11	[26]
<i>lecomtei</i>, <i>Lentinus</i> [Fr.:Fr. 1825]	388	[-]
= <i>Agaricus crinitus</i> Schwein. 1822, nom. illegit., non L.:Fr. 1763, nec Spreng. 1820		
<i>leiocephalus</i> [' <i>lejocephalus</i> '], <i>Agaricus</i> (<i>Volvaria</i>) [DC.:Fr. 1815]	138	[28 ' <i>lejocephalus</i> ']
<i>lejocephalus</i> [sic], <i>Agaricus</i> – See <i>leiocephalus</i> , <i>Agaricus</i>		
<i>lenticularis</i>, <i>Agaricus</i> (<i>Amanita</i>) [Lasch:Fr. 1828]	10	[26]
<i>lentiginosus</i>, <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1838, sp. nov.]	69	[95]
= <i>Agaricus ochraceus nanus</i> Secr. 1833, nom. inval.		
<i>Lentinus</i> [Fr.:Fr. 1825]	387, 602	[10, 480]
<i>lentus</i>, <i>Agaricus</i> (<i>Flammula</i>) [Pers.:Fr. 1801]	184	[246]
<i>Lenzites</i> [Fr. 1836]	403, 602	[10, 492]
<i>leoninus</i>, <i>Agaricus</i> (<i>Pluteus</i>) [Schaeff.:Fr. 1774]	142	[188]
<i>lepida</i>, <i>Russula</i> [Fr. 1836]	355	[444]
<i>lepideus</i>, <i>Lentinus</i> [(Fr.:Fr.) Fr. 1825]	390	[481]
= <i>Agaricus lepideus</i> Fr.:Fr. 1815		
<i>Lepiota</i>, <i>Agaricus</i> trib. [Fr.:Fr. 1821]	12, 596	[2, 29]
<i>lepista</i>, <i>Paxillus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	316	[402]
= <i>Agaricus lepista</i> Fr.:Fr. 1821		
<i>leporinus</i>, <i>Hygrophorus</i> [Fr. 1838, sp. nov.]	326	[412]
<i>leptocephalus</i>, <i>Agaricus</i> (<i>Mycena</i>) [Pers.:Fr. 1800]	109	[141]
<i>Leptonia</i>, <i>Agaricus</i> trib. [Fr.:Fr. 1821]	151, 598	[5, 201]
<i>leucocephalus</i>, <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	47	[71]
nom. illegit., non <i>Agaricus leucocephalus</i> Bull. 1789		
<i>leucophaeus</i>, <i>Cantharellus</i> [(Pers.) Nouel 1831]	367	[458]
= <i>Merulius cinereus</i> * <i>leucophaeus</i> Pers. 1825		
<i>leucophaeus</i>, <i>Hygrophorus glutinifer</i> var.		
[(Scop.) Fr. 1838, comb. nov.]	323	[408]
= <i>Agaricus leucophaeus</i> Scop. 1772		
<i>leucopus</i>, <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Pers.:Fr.) Fr. 1838, comb. nov.]	311	[395]
= <i>Agaricus leucopus</i> Pers.:Fr. 1801		
= <i>Agaricus leucopodius</i> Bull. 1792		

[Fries apparently mistook the orthography of Bulliard's epithet when he sanctioned this taxon as *Agaricus leucopus* and attributed it to Bulliard (Fries 1821, pp. 236, 511). The error was later acknowledged (Fries 1832, p. 27) but the orthography was never corrected. In all his publications (Fries 1818, 1821, 1832, 1838, 1874), Fries consistently treated *A. leucopodius* Bull. and *A. leucopus* Pers. (originally described as a distinct taxon) as synonyms, under the name '*Agaricus leucopus*'. It is therefore difficult to argue that the correct name for the sanctioned taxon should be *Agaricus leucopodius* Bull.:Fr., with Fries's '*leucopus*' orthography treated as a correctable lapsus calami.]

Taxon	Page	[Hym. Eur. page]
<i>libertatis</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Batsch 1783]	229	[300]
<i>licinipes</i> , <i>Cortinarius</i> (<i>Telamonia</i>) [Fr. 1838, sp. nov.]	293	[376]
<i>ligatus</i> , <i>Hygrophorus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	320	[405]
= <i>Agaricus ligatus</i> Fr.:Fr. 1821		
<i>lignatilis</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Pers.:Fr. 1801]	132	[169]
<i>lilacinus</i> , <i>Lactarius</i> [(Lasch:Fr.) Fr. 1838, comb. nov.]	348	[435]
= <i>Agaricus lilacinus</i> Lasch:Fr. 1828		
<i>limacinus</i> , <i>Hygrophorus</i> [(Scop.:Fr.) Fr. 1838, comb. nov.]	324	[409]
= <i>Agaricus limacinus</i> Scop.:Fr. 1772		
<i>limbatus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1838, nom. nov.]	201	[264]
= <i>Agaricus fimbriatus</i> Bull. 1792–93, nom. illegit., non Bolton:Fr. 1788		
<i>limonius</i> , <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	296	[379]
= <i>Agaricus limonius</i> Fr.:Fr. 1818		
<i>limosus</i> , <i>Agaricus</i> (<i>Nolanea</i>) [Fr.:Fr. 1828]	156	[206]
<i>limpidus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr. 1838, nom. nov.]	135	[177]
= <i>Agaricus lacteus</i> Scop. 1772, non Pers.:Fr. 1801		
<i>limulatus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr. 1818]	190	[252]
<i>lindgrenii</i> , <i>Cortinarius</i> (<i>Telamonia</i>) [Fr. 1838, sp. nov.]	300	[383]
<i>lineatus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Bull.:Fr. 1791]	103	[134]
<i>linkii</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Fr.:Fr. 1818]	151	[201]
<i>linnaei</i> , <i>Russula</i> [(Fr.) Fr. 1838, comb. nov.]	356	[444]
= <i>Agaricus linnaei</i> Fr. 1815		
<i>liquidus</i> , <i>Cortinarius</i> (<i>Myxacium</i>) [Fr. 1838, sp. nov.]	276	[357]
= <i>Agaricus dicroninus</i> Secr. 1833, nom. inval.		
<i>liquiritiae</i> , <i>Agaricus</i> (<i>Flammula</i>) [Pers. 1801]	190	[251]
<i>liratus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.]	272	[353]
<i>lithophilus</i> , † <i>Panus</i> [Fr. 1838, sp. nov.]	400	[–]
<i>lituus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr. 1838, sp. nov.]	121	[156]
= <i>Agaricus icmadophilus</i> Secr. 1833, nom. inval.		
<i>lividoalbus</i> , <i>Hygrophorus</i> [Fr. 1838, sp. nov.]	324	[412]
= <i>Agaricus eburneus</i> sensu Hornem. 1827, non Bull.:Fr. 1782–83		
<i>lividus</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Bull. 1788]	143	[189]
<i>livor</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.]	306	[390]
<i>lixivius</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, nom. nov.]	54	[77]
= <i>Agaricus compressus</i> With.:Fr. 1792		
<i>lobatus</i> , <i>Cantharellus</i> [(Pers.:Fr.) Fr. 1821]	369	[461]
= <i>Merulius lobatus</i> Pers.:Fr. 1801		
<i>longicaudus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Pers.:Fr. 1801]	181	[241]
<i>longipes</i> , <i>Agaricus</i> (<i>Collybia</i>) [Bull. 1785]	81	[110]
<i>loricatus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	37	[60]
<i>loripes</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	83	[111]
<i>loveianus</i> , <i>Agaricus</i> (<i>Volvaria</i>) [Berk. 1836]	139	[182]
<i>lubricus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Pers.:Fr. 1801]	185	[246]
<i>lucifer</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Lasch 1828]	167	[222]

Taxon	Page	[Hym. Eur. page]
<i>lucifugus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr.Fr. 1818]	177	[234]
<i>lucorum</i> , <i>Cortinarius</i> (<i>Telamonia</i>) <i>impennisi</i> var. [Fr. 1838, var. nov.]	294	[377]
<i>ludius</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	94	[124]
<i>lugens</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Jungh.:Fr. 1830]	181	[241]
<i>lugubris</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1821]	191	[253]
<i>lunatus</i> , <i>Panus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	399	[-]
= <i>Agaricus lunatus</i> Fr.:Fr. 1830		
<i>lupinus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr. 1838, sp. nov.]	185	[246]
<i>lupuletorum</i> , <i>Agaricus</i> (<i>Collybia</i>) [Weinm. 1826]	88	[118]
= <i>Agaricus dryophilus</i> γ <i>lupuletorum</i> (Weinm.) Weinm. 1836		
<i>luridus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Schaeff.:Fr. 1774]	31	[54]
non <i>Agaricus Lactifluus luridus</i> Pers.:Fr. 1801		
= <i>Agaricus schaefferi</i> Fr.:Fr. 1821		
= <i>Agaricus saponaceus</i> β Fr. 1830		
<i>luridus</i> , <i>Coprinus</i> [Fr. 1838, nom. nov.]	243	[322 sub <i>Coprinus</i>
= <i>Agaricus luridus</i> Bolton 1788, nom. illegit., non Schaeff.:Fr. 1774		<i>atramentarius</i>]
<i>luridus</i> , <i>Lactarius</i> [(Pers.:Fr.) Gray 1821]	338	[426]
= <i>Agaricus Lactifluus luridus</i> Pers.:Fr. 1801, non <i>Agaricus luridus</i> Schaeff.:Fr. 1774		
<i>luscinus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1818]	57	[81]
<i>lustratus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.]	258	[337]
<i>lutea</i> , <i>Russula</i> [(Huds.:Fr.) Fr. 1838, comb. nov.]	363	[454]
= <i>Agaricus luteus</i> Huds.:Fr. 1778		
<i>luteoalbus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Bolton:Fr. 1788]	103	[134]
= <i>Mycena luteoalba</i> (Bolton:Fr.) Gray 1821		
<i>luteolus</i> , <i>Bolbitius</i> [(Lasch:Fr.) Fr. 1838, comb. nov.]	254	[335]
= <i>Agaricus luteolus</i> Lasch:Fr. 1829		
<i>luteonitens</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Fr.:Fr. 1821]	220	[286]
= <i>Agaricus nitens</i> Vahl:Fr. 1792, non Batsch:Fr. 1789		
<i>luteovirens</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Alb. & Schwein.:Fr. 1805]	35	[41]
<i>lutescens</i> , <i>Cantharellus tubaeformis</i> var. [Fr. 1838, var. nov.]	366	[457]
= <i>Helvella gelatinosa</i> Bull. 1790		
<i>luxurians</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr. 1838, sp. nov.]	164	[219]
<i>lysiophyllus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Fr.:Fr. 1830]	227	[-]

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<i>macilentus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr.:Fr. 1821]	93	[123]
<i>macropus</i> , <i>Cortinarius</i> (<i>Telamonia</i>) [(Fr.:Fr.) Fr. 1838, comb. nov.]	291	[374]
= <i>Agaricus macropus</i> Fr.:Fr. 1821		
<i>maculatus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Alb. & Schwein.:Fr. 1805]	84	[112]
<i>maculatus</i> , <i>Gomphidius</i> [(Scop.) Fr. 1838, comb. nov.]	319	[400]
= <i>Agaricus maculatus</i> Scop. 1772, non Alb. & Schwein.:Fr. 1805		
<i>maculosus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [(Pers.:Fr.) Fr. 1838, comb. nov.]	271	[352]
= <i>Agaricus maculosus</i> Pers.:Fr. 1801		

Taxon	Page	[Hym. Eur. page]
<i>madidus</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Fr. 1836]	144	[192]
<i>magnificus</i> , <i>Agaricus</i> (<i>Amanita</i>) [Fr. 1834]	10	[25]
<i>majalis</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Fr.:Fr. 1818]	147	[196]
<i>malachius</i>, <i>Cortinarius</i> (<i>Inoloma</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	280	[361]
= <i>Agaricus malachius</i> Fr.:Fr. 1818		
<i>malicorius</i>, <i>Cortinarius</i> (<i>Dermocybe</i>) [Fr. 1838, sp. nov.] . . .	289	[371]
<i>maluvium</i>, <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	47	[69]
<i>mammossus</i> , <i>Agaricus</i> (<i>Nolanea</i>) [L. 1753]	156	[207]
<i>mammossus</i>, <i>Lactarius</i> [Fr. 1838, nom. nov.]	347	[434]
= <i>Agaricus mammossus</i> Fr. ex Weinm. 1836, nom. illegit., non L. 1753, nec Bolton 1788		
<i>mappa</i> , <i>Agaricus</i> (<i>Amanita</i>) [Batsch 1783]	6	[19]
<i>Marasmius</i> [Fr. 1836]	372, 602	[9, 464]
<i>marginatus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Batsch 1789]	169	[225]
<i>marginellus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Pers.:Fr. 1801]	100	[131]
<i>maritimus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr. 1818]	172	[229]
<i>marzuolus</i> , ?[†] <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1821]	67	[93]
<i>mastoideus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Fr.:Fr. 1821]	14	[30]
<i>mastrucatus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr.:Fr. 1818]	137	[179]
<i>maurus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr.:Fr. 1821]	121	[156]
<i>maximus</i>, <i>Agaricus</i> (<i>Clitocybe</i>)		
[P.Gaertn., B.Mey. & Scherb. 1802]	67	[93]
= <i>Agaricus gibbus</i> γ <i>maximus</i> (P.Gaertn., B.Mey. & Scherb.:Fr.) Fr. 1828		
<i>medius</i> , <i>Agaricus</i> (<i>Volvaria</i>) [Schumach.:Fr. 1803]	139	[184]
<i>medullatus</i>, <i>Agaricus</i> (<i>Lepiota</i>) [Fr. 1838, sp. nov.]	19	[38]
= <i>Agaricus illinitus</i> Secr. 1833, nom. inval. et illegit., non Fr.:Fr. 1818		
<i>melaleucus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Pers.:Fr. 1801]	51	[74]
<i>melanodon</i>, ? <i>Agaricus</i> (<i>Pluteus</i>) [Secr. ex Fr. 1838, sp. nov.] .	141	[187]
= <i>Agaricus melanodon</i> Secr. 1833, nom. inval.		
<i>melanospermus</i> ['<i>melaspermus</i>'], <i>Agaricus</i> (<i>Psalliota</i>)		
[Bull. ex Pers.:Fr. 1801]	219	[285 ' <i>melaspermus</i> ']
<i>melaspermus</i> [sic], <i>Agaricus</i> – See <i>melanospermus</i> , <i>Agaricus</i>		
<i>meleagris</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Sowerby 1798–99]	37	[31]
<i>melinoides</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Bull.:Fr. 1792–93]	195	[257]
<i>melizeus</i>, <i>Hygrophorus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	321	[406]
= <i>Agaricus melizeus</i> Fr.:Fr. 1818		
<i>melleopallens</i>, <i>Cortinarius</i> (<i>Telamonina</i>) <i>triformis</i> var.		
[Fr. 1838, var. nov.]	299	[383]
<i>melleus</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Vahl:Fr. 1790]	22	[44]
<i>membranaceus</i>, <i>Agaricus</i> (<i>Clitocybe</i>) <i>infundibuliformis</i> var.		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	68	[94]
= <i>Agaricus membranaceus</i> Vahl 1790, nom illegit., non Scop. 1772, nec Bolton 1778		
= <i>Agaricus flaccidus</i> β Fr. 1821		
= <i>Agaricus gibbus</i> δ <i>membranaceus</i> Fr.:Fr. 1828		
<i>mephiticus</i>, <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	96	[126]

Taxon	Page	[Hym. Eur. page]
<i>merdarius</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Fr.:Fr. 1821]	220	[286]
<i>mesomorphus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Bull.:Fr. 1791]	19	[38]
<i>mesophaeus</i>, <i>Agaricus</i> (<i>Hebeloma</i>) [(Pers.) Fr. 1838, comb. nov.]	179	[240]
= <i>Agaricus fastibilis</i> * <i>mesophaeus</i> Pers. 1828		
<i>metachrous</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1821]	77	[103]
<i>metapodius</i>, <i>Hygrophorus</i> [(Fr.) Fr. 1838, comb. nov.]	328	[415]
= <i>Agaricus metapodius</i> Fr. 1818		
<i>metatus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1821]	110	[142]
<i>micaceus</i>, <i>Coprinus</i> [(Bull.:Fr.) Fr. 1838, comb. nov.]	247	[325]
= <i>Agaricus micaceus</i> Bull.:Fr. 1785–86		
<i>micans</i>, <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1838, sp. nov.]	193	[255]
= <i>Agaricus alnicola</i> Secr. 1833, nom. inval. et illegit., non Fr.:Fr. 1821		
<i>melichianus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1818]	94	[124]
<i>microrhizus</i> , <i>Agaricus</i> (<i>Psathyra</i>) [Lasch:Fr. 1828]	234	[309]
<i>microscopicus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Wirtg. 1835]	128	[165]
<i>miculatus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1818]	36	[60]
<i>militaris</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Lasch 1828]	49	[71]
<i>millus</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Sowerby:Fr. 1798–99]	23	[44]
<i>miltnus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>) [Fr. 1838, sp. nov.]	287	[369]
<i>milvinus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.]	314	[399]
<i>miniatus</i>, <i>Hygrophorus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	330	[418]
= <i>Agaricus miniatus</i> Fr.:Fr. 1821		
<i>mitis</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Pers.:Fr. 1796]	135	[177]
<i>mitissimus</i>, <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	345	[437]
= <i>Agaricus mitissimus</i> Fr.:Fr. 1821		
<i>mixtus</i>, <i>Agaricus</i> (<i>Flammula</i>) [Fr. 1838, sp. nov.]	185	[246]
<i>mniophilus</i> , <i>Agaricus</i> (<i>Galera</i>) [Lasch:Fr. 1828]	207	[270]
<i>mollis</i> , <i>Agaricus</i> (<i>Crepidotus</i>) [Schaeff.:Fr. 1774]	210	[275]
<i>molochinus</i>, <i>Marasmius</i> [Fr. 1838, sp. nov.]	377	[318 as <i>Agaricus</i> <i>molochinus</i>]
<i>molybdinus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1821]	64	[89]
<i>molybdites</i> , <i>Agaricus</i> (<i>Lepiota</i>) [G.Mey. 1818]	13	[30]
<i>molyoides</i>, <i>Marasmius</i> [Fr. 1838, nom. nov.]	382	[475]
= <i>Agaricus clavatus</i> Schumach. 1803, nom. illegit., non Batsch 1783, nec With. 1796		
<i>Montagnites</i> [Fr. 1838, nom. nov.]	240, 600	[7, 319]
= <i>Montagnea</i> Fr. 1836		
<i>morchellaeformis</i> [sic], <i>Stylobates</i> – See <i>morchelliformis</i> , <i>Stylobates</i> <i>morchelliformis</i>, <i>Stylobates</i> [Fr. 1838, sp. nov., ‘ <i>morchellaeformis</i> ’]	370	[–]
<i>morio</i>, <i>Agaricus</i> (<i>Armillaria</i>) [Fr. 1838, sp. nov.]	23	[45]
<i>mortuosus</i>, <i>Agaricus</i> (<i>Clitocybe</i>) [(Fr.) Fr. 1838, comb. nov.]	79	[105]
= <i>Agaricus metachrous</i> β <i>mortuosus</i> Fr. 1818		
<i>mucidus</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Schrاد.:Fr. 1794]	24	[46]
<i>mucifluus</i>, <i>Cortinarius</i> (<i>Myxacium</i>) [Fr. 1838, sp. nov.]	274	[355]

Taxon	Page	[Hym. Eur. page]
<i>mucor</i> , <i>Agaricus</i> (<i>Mycena</i>) [Batsch:Fr. 1786]	117	[152]
<i>mucosus</i> , <i>Cortinarius</i> (<i>Myxacium</i>) <i>collinitus</i> var. [(Bull.:Fr.) Fr. 1838, comb. nov.]	274	[355]
= <i>Agaricus mucosus</i> Bull. 1792		
= <i>Agaricus collinitus</i> var. <i>mucosus</i> (Bull.:Fr.) Fr. 1821		
<i>mucronellus</i> , <i>Hygrophorus</i> [Fr. 1838, sp. nov.]	331	[418]
= <i>Agaricus puniceus</i> β <i>acutus</i> Lasch 1828		
<i>muelleri</i> ['müller?'], <i>Agaricus</i> (<i>Pholiota</i>) <i>squarrosus</i> var. [Fr.:Fr. 1821]	166	[221 'müller?']
müller [sic], <i>Agaricus</i> – See <i>muelleri</i> , <i>Agaricus</i>		
<i>mulleus</i> , <i>Marasmius</i> [Fr. 1838, sp. nov.]	374	[466]
= <i>Agaricus peronatus</i> sensu Lasch 1828, non Bolton:Fr. 1788		
<i>multiformis</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, nom. nov.]	263	[343]
= <i>Agaricus multiformis</i> Fr. 1818, nom. illegit., non Schaeff. 1774		
<i>mundulus</i> , <i>Agaricus</i> (<i>Clitopilus</i>) [Lasch:Fr. 1829]	149	[198]
<i>muralis</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Sowerby:Fr. 1800–03]	124	[160]
<i>murcidus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Fr.:Fr. 1821]	227	[303]
<i>muricatus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr.:Fr. 1821]	168	[223]
<i>muricinus</i> , <i>Cortinarius</i> (<i>Inoloma</i>) [Fr. 1838, sp. nov.]	279	[361]
<i>murinaceus</i> , <i>Hygrophorus</i> [(Bull.:Fr.) Fr. 1838, comb. nov.]	333	[421 sensu Fr., sub <i>Hygrophorus nitratus</i> (cf. p. 62 <i>Agaricus murinaceus</i> Bull.)]
= <i>Agaricus murinaceus</i> Bull.:Fr. 1791		
<i>murinus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Batsch:Fr. 1783]	97	[128]
<i>muscarius</i> , <i>Agaricus</i> (<i>Amanita</i>) [L.:Fr. 1753]	5	[20]
= <i>Amanita muscaria</i> (L.:Fr.) Lam. 1783		
<i>muscigenus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Schumach.:Fr. 1803]	94	[124]
<i>muscigenus</i> , <i>Cantharellus</i> [(Bull.:Fr.) Fr. 1821]	368	[460]
= <i>Agaricus muscigenus</i> Bull.:Fr. 1786		
<i>muscorum</i> , <i>Cantharellus</i> [(Roth:Fr.) Fr. 1821]	369	[461]
= <i>Merulius muscorum</i> Roth:Fr. 1791		
<i>mussivus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr. 1838, sp. nov.]	178	[237]
<i>mustelina</i> , <i>Russula</i> [Fr. 1838, sp. nov.]	351	[441]
<i>mustelinus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr. 1838, sp. nov.]	169	[225]
= <i>Agaricus xylophilus</i> Secr. 1833, nom. inval. et illegit., non Bull. 1792, nec (Pers.) Pers. 1801		
<i>musteus</i> , <i>Lactarius</i> [Fr. 1838, sp. nov.]	337	[425]
= <i>Agaricus vietus</i> Secr. 1833, nom. inval. et illegit., non Fr.:Fr. 1821		
<i>mutabilis</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Schaeff.:Fr. 1774]	169	[225]
<i>mutilis</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr.:Fr. 1821]	134	[173]
<i>mya</i> , <i>Schizophyllum</i> ? [(Scop.) Fr. 1838, comb. nov.]	403	[492]
= <i>Agaricus mya</i> Scop. 1770		
<i>Mycena</i> , <i>Agaricus</i> trib. [(Pers.:Fr.) Fr. 1821]	99, 597	[3, 129]
= <i>Agaricus</i> sect. <i>Mycena</i> Pers.:Fr. 1797		
= <i>Mycena</i> (Pers.:Fr.) Roussel 1806		

Taxon	Page	[Hym. Eur. page]
<i>mycenoides</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr.:Fr. 1821]	170	[226]
<i>mycenopsis</i> , <i>Agaricus</i> (<i>Galera</i>) [Fr. 1838, nom. nov.]	208	[271]
= <i>Agaricus mycenoides</i> Fr. 1818, non Fr.:Fr. 1821		
<i>myosotis</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1818]	198	[261]
<i>myosurus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr.:Fr. 1818]	89	[118]
<i>myrtilinus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>) [Fr. 1838, nom. nov.]	285	[368]
= <i>Agaricus bulbosus</i> Bolton 1792, non Sowerby:Fr. 1798–99		
<i>Myxadium</i> , <i>Cortinarius</i> “trib.”		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	273, 600	[8, 354]
= <i>Agaricus</i> trib. <i>Myxadium</i> Fr.:Fr. 1821		
N		
<i>nanus</i> , <i>Agaricus</i> (<i>Pluteus</i>) [Pers.:Fr. 1801]	141	[187]
<i>napus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.]	263	[343]
<i>narcoticus</i> , <i>Coprinus</i> [(Batsch:Fr.) Fr. 1838, comb. nov.]	250	[329]
= <i>Agaricus narcoticus</i> Batsch:Fr. 1786		
<i>naucinus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Fr. 1838, nom. nov.]	16	[34]
= <i>Hypophyllum scissum</i> Paulet ?1793		
<i>Naucoria</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	191, 599	[6, 253]
<i>nauseosa</i> , <i>Russula</i> [(Pers.) Fr. 1838, comb. nov.]	363	[454]
= <i>Agaricus Russula nauseosus</i> Pers. 1801		
<i>nebularis</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Batsch:Fr. 1789]	55	[79]
<i>nefrens</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Fr.:Fr. 1821]	155	[205]
<i>neglectus</i> , <i>Agaricus</i> (<i>Clitopilus</i>) [Lasch 1828]	151	[200]
<i>nemorensis</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) <i>variecolor</i> var.		
[Fr. 1838, var. nov.]	259	[339]
<i>nemoreus</i> , <i>Hygrophorus</i> [Fr. 1838, sp. nov.]	326	[413]
= <i>Agaricus nemoreus</i> sensu Lasch 1828, non Pers.:Fr. 1801		
<i>nictitans</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1821]	28	[50]
<i>nidorosus</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Fr. 1838, sp. nov.]	148	[196]
<i>nidulans</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Pers.:Fr. 1798]	136	[178]
<i>nidus-avis</i> , <i>Agaricus</i> (<i>Clitopilus</i>) [Secr. ex Fr. 1838, sp. nov.]	150	[200]
= <i>Agaricus nidus-avis</i> Secr. 1833, nom. inval.		
<i>niger</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Schwein.:Fr. 1822]	137	[–]
<i>nigricans</i> , <i>Russula</i> [Fr. 1838, nom. nov.]	350	[439]
= <i>Agaricus nigricans</i> Bull. 1785, nom. illegit., non O.F.Müll. 1782		
<i>nigripes</i> , <i>Agaricus</i> (<i>Nolanea</i>) [Trog 1832]	156	[207]
nom. illegit., non <i>Agaricus nigripes</i> Bull. 1788, nec Schwein.:Fr. 1822		
<i>nigripes</i> , <i>Lentinus</i> [Fr. ex Klotzsch 1833]	387	[–]
<i>nigripes</i> , <i>Marasmius</i> [(Schwein.:Fr.) Fr. 1838, comb. nov.]	383	[–]
= <i>Agaricus nigripes</i> Schwein.:Fr. 1822		
<i>nigropunctatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Secr. ex Fr. 1838, sp. nov.]	80	[107]
= <i>Agaricus nigropunctatus</i> Secr. 1833, nom. inval.		
<i>nimbatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Batsch 1786]	57	[81]
<i>nitellinus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1838, sp. nov.]	80[bis]	[120]

Taxon	Page	[Hym. Eur. page]
<i>nitida</i> , <i>Russula</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	361	[452]
= <i>Agaricus Russula nitidus</i> Pers.:Fr. 1801		
<i>nitidus</i> , <i>Agaricus</i> (<i>Amanita</i>) [(Fr.) Fr. 1838, comb. nov.]	8	[24]
nom. illegit., non <i>Agaricus nitidus</i> Schaeff. 1774, nec <i>Agaricus Russula nitidus</i> Pers.:Fr. 1801		
= <i>Amanita nitida</i> Fr. 1815		
<i>nitidus</i> , <i>Cortinarius</i> (<i>Myxaciium</i>) [(Schaeff.) Fr. 1838, comb. nov.]	275	[356]
= <i>Agaricus nitidus</i> Schaeff. 1774, non <i>Agaricus Russula nitidus</i> Pers.:Fr. 1801		
<i>niveus</i> , <i>Coprinus</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	246	[325]
= <i>Agaricus Coprinus niveus</i> Pers.:Fr. 1801		
<i>niveus</i> , <i>Hygrophorus</i> [(Scop.) Fr. 1838, comb. nov.]	327	[414]
= <i>Agaricus niveus</i> Scop. 1772, non <i>Agaricus Coprinus niveus</i> Pers.:Fr. 1801		
<i>Nolanea</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	155, 598	[5, 206]
<i>noli-tangere</i> , <i>Agaricus</i> (<i>Psathyra</i>) [Fr. 1838, sp. nov.]	234	[309]
= <i>Agaricus xylophilus</i> sensu Sowerby 1798–99, ‘ <i>zylophilus</i> ’, non Bull. 1792		
<i>nubilus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1838, sp. nov.]	77	[104]
<i>nuceus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Bolton 1788]	194	[258]
<i>nucisedus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Fr.:Fr. 1818]	230	[300]
<i>nudipes</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr. 1838, sp. nov.]	181	[242]
<i>nudus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Bull.:Fr. 1790]	48	[72]
<i>nummularius</i> , <i>Agaricus</i> (<i>Collybia</i>) [(Lam.) Fr. 1838, comb. nov.]	91	[120]
= <i>Amanita nummularia</i> Lam. 1783		
<i>nutans</i> , † <i>Agaricus</i> (<i>Panaeolus</i>) [Fr.:Fr. 1821]	235	[–]
<i>Nyctalis</i> [Fr. 1825]	370, 602	[9, 462]
<i>nycthemerus</i> , <i>Coprinus</i> [Fr. 1838, sp. nov.]	251	[330]

O

<i>obobatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1838, sp. nov.]	74	[101]
<i>oblectus</i> , <i>Coprinus</i> [(Bolton) Gray 1821]	243	[321]
= <i>Agaricus oblectus</i> Bolton 1792		
<i>obliquus</i> , <i>Lactarius</i> [Fr. 1838, sp. nov.]	348	[438]
= <i>Agaricus pubescens</i> Secr. 1833, nom. inval. et illegit., non Scop. 1770, nec Schrad. 1794, nec (Schwein.) Schwein. 1832		
<i>obolus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1821]	78	[104]
<i>obrusseus</i> , <i>Hygrophorus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	331	[419]
= <i>Agaricus obrusseus</i> Fr.:Fr. 1821		
<i>obscuratus</i> , <i>Lactarius</i> [(Lasch:Fr.) Fr. 1838, comb. nov.]	346	[438 sub <i>Lactarius</i> <i>obnubilus</i>]
= <i>Agaricus obscuratus</i> Lasch:Fr. 1828		
<i>obscurus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Pers. 1801]	173	[231]
nom. illegit., non <i>Agaricus obscurus</i> Schaeff. 1774		
<i>obsoletus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Batsch 1786]	78	[105]
<i>obtextus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) <i>cerussatus</i> var. [(Lasch) Fr. 1838, comb. nov.]	62	[86]
= <i>Agaricus obtextus</i> Lasch:Fr. 1828		
<i>obturatorus</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Fr.:Fr. 1821]	219	[285]

Taxon	Page	[Hym. Eur. page]
<i>obtusatus</i> , <i>Agaricus</i> (<i>Psathyra</i>) [Fr.:Fr. 1821]	232	[306]
<i>obtus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	313	[397]
= <i>Agaricus obtusus</i> Fr.:Fr. 1821		
<i>ocellatus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr.:Fr. 1815]	94	[123]
<i>ochracea</i> , <i>Russula</i> [Fr. 1838, nom. nov.]	362	[453]
= <i>Agaricus ochraceus</i> $\beta\beta$ <i>unicolor</i> Alb. & Schwein. 1805		
<i>ochraceofuscus</i> , † <i>Lentinus</i> (<i>Scleroma</i>)		
[(G.Mey.:Fr.) Fr. 1838, comb. nov.]	391	[-]
= <i>Agaricus ochraceofuscus</i> G.Mey.:Fr. 1818		
<i>ochroleuca</i> , <i>Russula</i> [Pers. 1796]	358	[449]
= <i>Agaricus Russula ochroleucus</i> (Pers.) Pers. 1801, nom. illegit., non <i>Agaricus ochroleucus</i> Schaeff.:Fr. 1774		
<i>ochroleucus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>)		
[(Schaeff.:Fr.) Fr. 1838, comb. nov.]	284	[366]
= <i>Agaricus ochroleucus</i> Schaeff.:Fr. 1774		
<i>ocreatus</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Holmsk.:Fr. 1799]	216	[288]
<i>odorus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Bull.:Fr. 1783–84]	59	[85]
<i>oedematopus</i> , <i>Agaricus</i> (<i>Collybia</i>) <i>fusipes</i> ? var.		
[(Schaeff.) Fr. 1838, comb. nov.]	83	[112]
= <i>Agaricus oedematopus</i> Schaeff.:Fr. 1774		
<i>oedematopus</i> , <i>Lactarius volemus</i> var.		
[(Scop.) Fr. 1838, comb. nov.]	345	[436]
= <i>Agaricus oedematopus</i> Scop. 1772, non Schaeff.:Fr. 1774		
<i>offuciatus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr. 1838, sp. nov.]	121	[156]
<i>olearius</i> , <i>Agaricus</i> (<i>Crepidotus</i>) [DC.:Fr. 1815]	210	[170]
<i>olivacea</i> , <i>Russula</i> [(Schaeff.) Fr. 1838, comb. nov.]	356	[445 ‘non Pers.’]
nom. illegit., non <i>Russula olivacea</i> Pers. 1796 [= <i>Russula olivascens</i> Pers. 1801]		
= <i>Agaricus olivaceus</i> Schaeff. 1774		
<i>olivaceoalbus</i> , <i>Hygrophorus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	324	[410]
= <i>Agaricus olivaceoalbus</i> Fr.:Fr. 1815		
<i>olivascens</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Batsch) Fr. 1838, comb. nov.]	273	[354]
= <i>Agaricus olivascens</i> Batsch 1789		
<i>olivascens</i> , <i>Russula grisea</i> var. [Secr. ex Fr. 1838, var. nov.]	361	[-]
= <i>Agaricus olivascens</i> Secr. 1833, nom. inval. et illegit., non Batsch 1789, nec Pers. 1801		
<i>olorinus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1818]	63	[88]
<i>Omphalia</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	119, 598	[4, 154]
<i>oniscus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr.:Fr. 1818]	123	[158]
<i>onychinus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, nom. nov.]	41	[64]
= <i>Agaricus flavus</i> Lasch 1829, nom. illegit., non With. 1792		
<i>opacus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [With. 1792]	67	[93]
<i>opalus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) <i>tornatus</i> var. [Fr. 1838, var. nov.]	63	[87]
<i>opicus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1818]	39	[63]
<i>opimus</i> , <i>Cortinarius</i> (<i>Inoloma</i>) [Fr. 1838, sp. nov.]	278	[359]

Taxon	Page	[Hym. Eur. page]
<i>opiparus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1838, nom. nov.]	59	[83]
= <i>Agaricus roseus</i> Schaeff. 1774, nom. illegit., non Scop.:Fr. 1772		
<i>orbicularis</i> , <i>Agaricus</i> (<i>Collybia</i>) [Secr. ex Fr. 1838, sp. nov.] . . .	89	[118]
= <i>Agaricus orbicularis</i> Secr. 1833, nom. inval.		
<i>orbiformis</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1838, sp. nov.]	76	[103]
<i>orcella</i> , <i>Agaricus</i> (<i>Clitopilus</i>) [Bull.:Fr. 1793]	149	[197]
<i>oreades</i> , <i>Marasmius</i> [(Bolton:Fr.) Fr. 1836]	375	[467]
= <i>Agaricus oreades</i> Bolton:Fr. 1792		
<i>oreinus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1818]	46	[70]
<i>orellanus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>) [Fr. 1838, sp. nov.] . . .	288	[371]
<i>orichalceus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Batsch) Fr. 1838, comb. nov.]	267	[348]
= <i>Agaricus orichalceus</i> Batsch 1789		
<i>ornatus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr. 1838, sp. nov.]	130	[168]
<i>ostreatus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Jacq.:Fr. 1774]	133	[173]
<i>ovatus</i> , <i>Coprinus</i> [(Schaeff.:Fr.) Fr. 1838, comb. nov.]	242	[320]
= <i>Agaricus ovatus</i> Schaeff.:Fr. 1774		
<i>ovinus</i> , <i>Hygrophorus</i> [(Bull.:Fr.) Fr. 1836]	328	[415]
= <i>Agaricus ovinus</i> Bull.:Fr. 1793		
<i>ovoideus</i> , <i>Agaricus</i> (<i>Amanita</i>) [Vent.:Fr. 1812]	3	[18]
= <i>Agaricus ovooides albus</i> Bull. 1788		
<i>ozes</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	95	[125]

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<i>pachyphyllus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1815]	80	[107]
<i>paedidus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	53	[77]
<i>paeonius</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	42	[65 sub <i>Agaricus carneus</i>]
<i>paleaceus</i> , <i>Cortinarius</i> (<i>Telamonia</i>) [Fr. 1838, sp. nov.]	302	[386]
= <i>Agaricus iliopodius</i> sensu Weinm. 1836, non <i>Agaricus ileopodius</i> Bull.:Fr. 1793		
<i>palisoti</i> [sic], <i>Lenzites</i> – See <i>palisotii</i> , <i>Lenzites</i>		
<i>palisotii</i> , <i>Lenzites</i> [(Fr.:Fr.) Fr. 1838, comb. nov., ‘ <i>palisoti</i> ’] . . .	404	[–]
= <i>Daedalea palisotii</i> Fr.:Fr. 1821		
<i>pallasii</i> , <i>Montagnites</i> [Fr. 1838, sp. nov.]	241	[–]
= <i>Boleti species singularis</i> Pall. 1773		
<i>pallidus</i> , <i>Lactarius</i> [Pers.:Fr. 1797]	343	[431]
= <i>Agaricus Lactifluus pallidus</i> (Pers.:Fr.) Pers. 1801		
<i>palmatus</i> , <i>Agaricus</i> (<i>Crepidotus</i>) [Bull.:Fr. 1785]	209	[275]
<i>paludosus</i> , <i>Agaricus</i> (<i>Galera</i>) [Fr. 1838, sp. nov.]	209	[273]
<i>Panaeolus</i> , <i>Agaricus</i> “trib.” [Fr. 1838, “trib.” nov.]	234, 599	[7, 309]
<i>panaeolus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	49	[73]
= <i>Agaricus ectypus</i> Secr. 1833, nom. inval. et illegit., non Fr.:Fr. 1821		
<i>pannosus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1821]	202	[265]
<i>pannucius</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	335	[423]
= <i>Agaricus pannucius</i> Fr.:Fr. 1821		

Taxon	Page	[Hym. Eur. page]
<i>pansa, Cortinarius (Phlegmacium)</i>		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	264	[344]
= <i>Agaricus pansa</i> Fr.:Fr. 1818		
<i>pantherinus, Agaricus (Amanita)</i> [DC.:Fr. 1815]	5	[21]
<i>panuoides, Paxillus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	318	[404]
= <i>Agaricus panuoides</i> Fr.:Fr. 1818		
<i>Panus</i> [Fr. 1838, gen. nov.]	396, 602	[10, 487]
<i>papilionaceus, Agaricus (Panaeolus)</i> [Bull.:Fr. 1781–82]	236	[311]
<i>papillatus, Coprinus</i> [(Batsch:Fr.) Fr. 1838, comb. nov.]	248	[326]
= <i>Agaricus papillatus</i> Batsch:Fr. 1786		
<i>papulosus, Cortinarius (Phlegmacium)</i> [Fr. 1838, sp. nov.]	271	[352]
<i>parabolicus, Agaricus (Mycena)</i> [Fr. 1838, sp. nov.]	107	[139]
= <i>Agaricus atroalbus</i> sensu Alb. & Schwein. 1805, non Bolton:Fr. 1790		
<i>paradoxus, Stylobates</i> [Fr. 1837]	370	[–]
<i>paragaudis, Cortinarius (Telamonia)</i> [Fr. 1838, sp. nov.]	295	[379]
<i>parasitica, Nyctalis</i> [(Bull. ex Pers.:Fr.) Fr. 1838, comb. nov.]	372	[464]
= <i>Agaricus parasiticus</i> Bull. ex Pers.:Fr. 1801		
<i>pergamenus</i> [sic], <i>Lactarius</i> – See <i>pergamenus, Lactarius</i>		
<i>parilis, Agaricus (Clitocybe)</i> [Fr.:Fr. 1818]	69	[95]
<i>paropsis, Agaricus (Clitocybe)</i> [Fr. 1838, sp. nov.]	72	[98]
<i>parvannulatus, Agaricus (Lepiota)</i> [Lasch:Fr. 1828]	18	[37]
<i>parvulus, Agaricus (Volvaria)</i> [Weinm. 1826]	139	[184]
<i>pascuus, Agaricus (Nolanea)</i> [Pers.:Fr. 1800]	155	[206]
<i>patellaris, Panus</i> [Fr. 1838, sp. nov.]	400	[490]
<i>pateriformis, Cortinarius (Hydrocybe)</i> [Fr. 1838, sp. nov.]	310	[394]
<i>patulus, Agaricus (Tricholoma)</i> [Fr. 1838, sp. nov.]	47	[69]
<i>pauletii, Agaricus (Lepiota)</i> [Fr. 1838, nom. nov.]	17	[36]
= <i>Hypophyllum radula</i> Paulet ?1793		
<i>pausiacus, Agaricus (Clitocybe)</i> [Fr. 1838, sp. nov.]	77	[104]
<i>pavonius, Cortinarius (Inoloma)</i> [Fr. 1838, sp. nov.]	282	[363]
<i>Paxillus</i> [Fr. 1836]	315, 601	[8, 400]
<i>paxillus, Agaricus (Pholiota)</i> [Fr. 1838, sp. nov.]	168	[224]
<i>pectinata, Russula</i> [Fr. 1838, sp. nov.]	358	[449]
= <i>Agaricus pectinaceus</i> Bull. 1791, pro parte		
<i>pectinatus, Lentinus</i> [(Schwein.:Fr.) Fr. 1838, comb. nov.]	396	[–]
= <i>Agaricus pectinatus</i> Schwein.:Fr. 1822		
<i>pediades, Agaricus (Naucoria)</i> [Fr.:Fr. 1821]	197	[260]
<i>pelianthinus, Agaricus (Mycena)</i> [Fr.:Fr. 1821]	99	[130]
<i>pelliculosus, Agaricus (Mycena)</i> [Fr. 1838, sp. nov.]	116	[149]
nom. illegit., non <i>Agaricus pelliculosus</i> Schwein.:Fr. 1822		
<i>pelliculosus, Lentinus</i> [(Schwein.:Fr.) Fr. 1828]	395	[–]
= <i>Agaricus pelliculosus</i> Schwein.:Fr. 1822		
<i>pellitus, Agaricus (Pluteus)</i> [Pers.:Fr. 1801]	141	[187]
<i>pellucidus, Agaricus (Galera)</i> [Bull.:Fr. 1792]	208	[273]
<i>peltatus, Agaricus (Mycena)</i> [Fr. 1838, sp. nov.]	110	[142]
= <i>Agaricus ambustus</i> Secr. 1833, nom. inval.		

Taxon	Page	[Hym. Eur. page]
<i>penarius</i> , <i>Hygrophorus</i> [Fr. 1836]	321	[406]
<i>penetrans</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr. 1815]	189	[250]
<i>penicillatus</i> , <i>Cortinarius</i> (<i>Inoloma</i>) [Fr. 1838, sp. nov.]	283	[365]
<i>pennatus</i> , <i>Agaricus</i> (<i>Psathyra</i>) [Fr.:Fr. 1821]	234	[308]
<i>perbrevis</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Weinm. 1836]	175	[233]
<i>percomis</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.]	260	[340]
<i>peregrinus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr.:Fr. 1828]	191	[-]
<i>perforans</i> , <i>Marasmius</i> [(Hoffm.:Fr.) Fr. 1838, comb. nov.]	385	[478]
= <i>Agaricus perforans</i> Hoffm.:Fr. 1789		
<i>pergamenus</i> , <i>Lactarius</i>		
[(Sw.:Fr.) Fr. 1838, comb. nov., ‘pargamenus’]	340	[430 ‘pargamenus’]
= <i>Agaricus pergamenus</i> Sw.:Fr. 1809		
<i>periscelis</i> , <i>Cortinarius</i> (<i>Telamonia</i>)		
[Weinm. ex Fr. 1838, sp. nov.]	300	[383]
<i>peronatus</i> , <i>Marasmius</i> [(Bolton:Fr.) Fr. 1836]	373	[465]
= <i>Agaricus peronatus</i> Bolton:Fr. 1788		
<i>perpusillus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Lumn.:Fr. 1791]	138	[181]
<i>persicinus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1821]	52	[76]
<i>personatus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1818]	48	[72]
<i>persoonii</i> , <i>Agaricus</i> (<i>Amanita</i>) [Fr.:Fr. 1818]	10	[25]
<i>pes-caprae</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	45	[68]
<i>pessundatus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1821]	29	[51]
<i>petalodes</i> [‘petaloides’], <i>Agaricus</i> (<i>Pleurotus</i>) [Bull.:Fr. 1785]	134	[175 ‘petaloides’]
<i>petaloides</i> [sic], <i>Agaricus</i> – See <i>petalodes</i> , <i>Agaricus</i>		
<i>petasatus</i> , <i>Agaricus</i> (<i>Pluteus</i>) [Fr. 1838, sp. nov.]	142	[186 as <i>Agaricus</i>
<i>cervinus</i> * <i>petasatus</i>]		
<i>petiginosus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr.:Fr. 1821]	180	[243]
<i>pezizoides</i> , <i>Agaricus</i> (<i>Crepidotus</i>) [Nees & T.Nees:Fr. 1818]	212	[277]
<i>phaeopodius</i> , <i>Agaricus</i> (<i>Collybia</i>) [Bull.:Fr. 1792]	85	[113]
<i>phaeocephalus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) <i>furvus</i> var.		
[(Bull.:Fr.) Fr. 1838, comb. nov., ‘phajocephalus’]	34	[(190
= <i>Agaricus phaeocephalus</i> Bull.:Fr. 1792		‘phajocephalus’)]
<i>phajocephalus</i> [sic], <i>Agaricus furvus</i> – See <i>phaeocephalus</i> , <i>Agaricus furvus</i>		
<i>phalenaarum</i> , <i>Agaricus</i> (<i>Panaeolus</i>) [Fr. 1838, sp. nov.]	235	[310 ‘phalaenarum’]
= <i>Agaricus papilionaceus</i> Bull.:Fr. 1781-82, pro parte		
= <i>Agaricus papilionaceus luteus</i> Secr. 1833, nom. inval.		
<i>phaleratus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr. 1838, sp. nov.]	169	[224]
<i>phalloides</i> , <i>Agaricus</i> (<i>Amanita</i>) [Fr.:Fr. 1821]	4	[18]
<i>philonotis</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Lasch 1828]	123	[158]
<i>phlebophorus</i> , <i>Agaricus</i> (<i>Pluteus</i>) [Ditmar:Fr. 1813]	142	[188]
<i>Phlegmacium</i> , <i>Cortinarius</i> “trib.”		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	256, 600	[8, 336]
= <i>Agaricus trib. Phlegmacium</i> Fr.:Fr. 1821		
<i>phoeniceus</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Fr. 1838, sp. nov.]	20	[40]

Taxon	Page	[Hym. Eur. page]
<i>phoenix</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Fr. 1838, sp. nov.]	225	[301]
= <i>Agaricus subliquescens</i> Secr. 1833, nom. inval. et illegit., non Schumach.:Fr. 1803		
<i>pholideus</i> , <i>Cortinarius</i> (<i>Inoloma</i>)		
[(Lilj.:Fr.) Fr. 1838, comb. nov.]	282	[364]
= <i>Agaricus pholideus</i> Lilj.:Fr. 1816		
<i>Pholiota</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	160, 598	[5, 214]
<i>phrygianus</i> , <i>Cortinarius</i> (<i>Inoloma</i>) <i>sublanatus</i> var.		
[Fr. 1838, var. nov.]	283	[365 as <i>Cortinarius phrygianus</i>]
<i>phyllophilus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Pers.:Fr. 1801]	62	[87]
<i>physaloides</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Bull.:Fr. 1792–93]	229	[300]
<i>picaceus</i> , <i>Coprinus</i> [(Bull.:Fr.) Gray 1821]	244	[323]
= <i>Agaricus picaceus</i> Bull.:Fr. 1785		
<i>picinus</i> , <i>Lactarius</i> [Fr. 1838, sp. nov.]	348	[435]
<i>picreus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Pers.:Fr. 1798]	190	[251]
<i>pictus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr.:Fr. 1815]	126	[163]
<i>pilipes</i> , <i>Agaricus</i> (<i>Galera</i>) [Sowerby:Fr. 1800–03]	203	[318]
[Mistranscribed as ‘ <i>filipes</i> ’ [sic] in Petersen 1983, Mycotaxon 17: 163]		
<i>pilosus</i> , <i>Lentinus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	395	[–]
= <i>Agaricus pilosus</i> Fr.:Fr. 1830		
<i>piluliformis</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Bull.:Fr. 1782–83]	25	[296 ‘ <i>pilulaeformis</i> ’]
<i>pinguis</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Fr. 1838, sp. nov.]	19	[39]
<i>piniarius</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Bosc:Fr. 1811]	59	[–]
<i>pinsitus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr.:Fr. 1821]	136	[178]
<i>piperatus</i> , <i>Lactarius</i> [(Scop.:Fr.) Pers. 1800]	340	[430]
= <i>Agaricus piperatus</i> Scop.:Fr. 1772		
<i>pithyophilus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Secr. ex Fr. 1838, sp. nov.] .	62	[87]
= <i>Agaricus pithyophilus</i> Secr. 1833, nom. inval.		
<i>pithyus</i> , <i>Agaricus</i> (<i>Mycena</i>) <i>lacteus</i> var.		
[Fr. 1838, nom. nov.]	103	[135]
= <i>Agaricus tener</i> Schumach. 1803, nom. illegit., non Schaeff.:Fr. 1774		
<i>pityreus</i> [sic], <i>Agaricus</i> – See <i>pityrius</i> , <i>Agaricus</i>		
<i>pityrius</i> [‘ <i>pityreus</i> ’], <i>Agaricus</i> (<i>Galera</i>) [Fr.:Fr. 1821]	204	[271]
<i>placenta</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Batsch 1783]	144	[190]
<i>placidus</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Fr.:Fr. 1818]	151	[201]
<i>plancus</i> , <i>Marasmius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	375	[468]
= <i>Agaricus plancus</i> Fr.:Fr. 1821		
<i>planus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr.:Fr. 1828]	135	[177]
= <i>Agaricus planus</i> ß <i>violaceoruber</i> Alb. & Schwein. 1805		
<i>platyphyllus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Pers.:Fr. 1796]	82	[110]
<i>plautus</i> , <i>Agaricus</i> (<i>Pluteus</i>) [Weinm. 1836]	141	[187]
<i>pleopodius</i> , <i>Agaricus</i> (<i>Nolanea</i>) [Bull. ex DC.:Fr. 1805]	157	[209]
<i>Pleurotus</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	129, 598	[4, 166]
<i>plexipes</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr.:Fr. 1821]	96	[126]
<i>plicatilis</i> , <i>Coprinus</i> [(Curtis:Fr.) Fr. 1838, comb. nov.]	252	[331]
= <i>Agaricus plicatilis</i> Curtis:Fr. 1781		

Taxon	Page	[Hym. Eur. page]
<i>plicosus</i> , <i>Agaricus</i> (<i>Mycena</i>) [(Fr.) Fr. 1838, comb. nov.]	110	[142]
= <i>Agaricus metatus</i> β <i>plicosus</i> Fr.:Fr. 1821		
<i>plumbeus</i> , <i>Lactarius</i> [(Bull.:Fr.) Gray 1821]	339	[429]
= <i>Agaricus lactifluus</i> var. <i>plumbeus</i> Bull. 1786		
= <i>Agaricus plumbeus</i> (Bull.:Fr.) Bull. 1792–93		
<i>plumbosus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.]	307	[391]
<i>plumiger</i> , <i>Cortinarius</i> (<i>Telamonia</i>) [Fr. 1838, sp. nov.]	294	[377]
<i>plumosus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Bolton:Fr. 1788]	172	[228]
<i>Pluteus</i> , <i>Agaricus</i> “trib.” [(Fr.) Fr. 1838, “trib.” nov.]	140, 598	[4, 185]
= <i>Pluteus</i> Fr. 1836		
<i>pluvius</i> , <i>Cortinarius</i> (<i>Myxacium</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	277	[359]
= <i>Agaricus pluvius</i> Fr.:Fr. 1821		
<i>polioleucus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) <i>melaleucus</i> var.		
[Fr.:Fr. 1821]	51	[75]
<i>polita</i> [sic], <i>Lenzites</i> – See <i>politus</i> , <i>Lenzites</i>		
<i>politus</i> , <i>Agaricus</i> (<i>Eccilia</i>) [Pers.:Fr. 1801]	159	[211]
<i>politus</i> , <i>Lenzites</i> [(Fr.:Fr.) Fr. 1838, comb. nov., ‘ <i>polita</i> ’]	404	[-]
= <i>Daedalea polita</i> Fr.:Fr. 1830		
<i>polius</i> , <i>Agaricus</i> (<i>Clitocybe</i>) <i>fumosus</i> var.		
[(Fr.:Fr.) Fr. 1821]	57	[80 as <i>Agaricus polius</i>]
= <i>Agaricus polius</i> Fr. 1815		
<i>polyadelphus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Lasch 1828]	128	[165]
<i>polycephalus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) <i>spadiceus</i> var.		
[(Paulet) Fr. 1838, comb. nov.]	226	[302]
= <i>Hypophyllum polycephalum</i> Paulet ?1793		
<i>polygrammus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Bull.:Fr. 1789]	107	[139]
= <i>Mycena polygramma</i> (Bull.:Fr.) Gray 1821		
<i>polyphyllus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [DC.:Fr. 1815]	33	[56]
<i>polytrichi</i> , <i>Agaricus</i> (<i>Psilocybe</i>) <i>udus</i> var. [(Fr.:Fr.) Fr. 1821]	228	[298]
= <i>Agaricus polytrichi</i> Fr. 1815		
<i>pometi</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [(Paulet) Fr. 1838, comb. nov.]	132	[173]
= <i>Hypophyllum pometi</i> Paulet ?1793		
<i>popinalis</i> , <i>Agaricus</i> (<i>Clitopilus</i>) [Fr.:Fr. 1821]	149	[198]
<i>porphyrius</i> , <i>Agaricus</i> (<i>Amanita</i>) [(Alb. & Schwein.:Fr.) Fr. 1821]	4	[19]
= <i>Amanita porphyria</i> Alb. & Schwein.:Fr. 1805		
<i>porphyroleucus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) <i>melaleucus</i> var.		
[Fr.:Fr. 1821]	51	[75]
<i>porphyropus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Alb. & Schwein.) Fr. 1838, comb. nov.]	271	[351]
= <i>Agaricus porphyropus</i> Alb. & Schwein. 1805		
<i>porreus</i> , <i>Marasmius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	374	[466]
= <i>Agaricus porreus</i> Fr.:Fr. 1818 [= <i>Agaricus porreus</i> Pers. 1801, pro parte]		
<i>porrigens</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Pers.:Fr. 1796]	136	[178]
<i>porriginosus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1838, sp. nov.]	200	[263]

Taxon	Page	[Hym. Eur. page]
<i>portentosus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1821]	26	[48]
<i>praecox</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Pers.:Fr. 1800]	162	[217]
<i>praegnans</i> , <i>Coprinus</i> [Fr. 1838, sp. nov.]	243	[321]
<i>praestigiatus</i> , <i>Cortinarius</i> (<i>Telamonia</i>) <i>paragaudis</i> var. [Fr. 1838, var. nov.]	295	[379]
<i>praetorius</i> , <i>Agaricus</i> (<i>Amanita</i>) [Fr. 1838, nom. nov.]	11	[26]
= <i>Hypophyllum castaneum</i> Paulet ?1793		
<i>prasinus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [(Schaeff.:Fr.) Fr. 1838, comb. nov.]	268	[348]
= <i>Agaricus prasinus</i> Schaeff.:Fr. 1774		
<i>prasiosmus</i> , <i>Marasmius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	376	[468]
= <i>Agaricus prasiosmus</i> Fr.:Fr. 1818		
<i>pratensis</i> , <i>Hygrophorus</i> [(Pers.:Fr.) Fr. 1836]	326	[413]
= <i>Agaricus pratensis</i> Pers.:Fr. 1800		
<i>praticola</i> , <i>Agaricus</i> (<i>Psalliota</i>) <i>campestris</i> var. [Vittad. 1832] .	213	[280 sub <i>Agaricus campestris</i>]
<i>pravus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) <i>ionides</i> var. [(Lasch) Fr. 1838, comb. nov.]	42	[65]
= <i>Agaricus pravus</i> Lasch:Fr. 1829		
<i>prescottii</i> , <i>Agaricus</i> (<i>Hypholoma</i>) [Weinm. 1836]	223	[292]
<i>princeps</i> , <i>Lentinus</i> (<i>Scleroma</i>) [Fr.:Fr. 1828]	392	[–]
<i>pristoides</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1821]	100	[130 sub <i>Agaricus balaninus</i>]
<i>privignus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [(Fr.) Fr. 1838, comb. nov.]	304	[388]
= <i>Agaricus malachius</i> β <i>privignus</i> Fr. 1818		
<i>proboscideus</i> , <i>Agaricus</i> (<i>Crepidotus</i>) [Fr.:Fr. 1818]	211	[277]
<i>procerus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Scop.:Fr. 1772]	12	[29]
= <i>Lepiota procera</i> (Scop.:Fr.) Gray 1821		
= <i>Amanita procera</i> (Scop.:Fr.) Fr. 1836		
<i>proletarius</i> , <i>Agaricus</i> (<i>Nolanea</i>) [Fr. 1836]	156	[206]
<i>prolifer</i> [' <i>proliferus</i> '], <i>Agaricus</i> (<i>Mycena</i>) [Sowerby 1798–99] . .	105	[137 ' <i>proliferus</i> ']
<i>proliferus</i> [sic], <i>Agaricus</i> – See <i>prolifer</i> , <i>Agaricus</i>		
<i>prolixus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr.:Fr. 1818]	84	[113]
<i>pronus</i> , <i>Agaricus</i> (<i>Psathyrella</i>) [Fr. 1838, sp. nov.]	239	[315]
<i>protractus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) <i>gilvus</i> var. [Fr. 1838, var. nov.]	70	[–]
<i>protractus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	97	[128]
<i>pruinosis</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Lasch ex Fr. 1838, sp. nov.] . .	75	[101]
<i>prunuloides</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Fr.:Fr. 1821]	143	[189]
<i>prunulus</i> , <i>Agaricus</i> (<i>Clitopilus</i>) [Scop.:Fr. 1772]	148	[197]
<i>Psalliota</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	212, 599	[7, 278]
<i>psammocephalus</i> , <i>Cortinarius</i> (<i>Telamonia</i>) [(Bull.) Fr. 1838, comb. nov.]	301	[384]
= <i>Agaricus psammocephalus</i> Bull. 1792		
<i>Psathyra</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	231, 599	[7, 304]

Taxon	Page	[Hym. Eur. page]
<i>Psathyrella</i> , <i>Agaricus</i> "trib." [Fr. 1838, "trib." nov.]	237, 599	[7, 313]
<i>Psilocybe</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	225, 599	[7, 297]
<i>psittacinus</i> , <i>Hygrophorus</i> [(Schaeff.:Fr.) Fr. 1838, comb. nov.]	332	[420]
= <i>Agaricus psittacinus</i> Schaeff.:Fr. 1774		
<i>pterigenus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1815]	118	[152]
<i>pubescens</i> , <i>Agaricus</i> (<i>Amanita</i>) [(Schwein.) Schwein. 1832]	12	[-]
nom. illegit., non <i>Agaricus pubescens</i> Scop. 1770, nec Schrad. 1794		
= <i>Amanita pubescens</i> Schwein. 1822		
<i>pubescens</i> , <i>Lactarius</i> [Fr. 1838, nom. nov.]	335	[424]
= <i>Agaricus pubescens</i> Schrad. 1794, nom. illegit., non Scop. 1770		
<i>pubicus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Bull. ex DC. 1805]	163	[218]
<i>pudorinus</i> , <i>Hygrophorus</i> [(Fr.:Fr.) Fr. 1836]	322	[407]
= <i>Agaricus pudorinus</i> Fr.:Fr. 1821		
<i>puellaris</i> , <i>Russula</i> [Fr. 1838, sp. nov.]	362	[452]
<i>pullatus</i> , <i>Coprinus fimetarius</i> var.		
[(Bolton) Fr. 1838, comb. nov.]	246	[324 sub <i>Coprinus</i>
= <i>Agaricus pullatus</i> Bolton 1788		<i>fimetarius</i> , as 'Bolt. t. 20']
<i>pullus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Schaeff. 1774]	85	[114]
<i>pulmonarius</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr.:Fr. 1821]	134	[176]
<i>pulverulentus</i> , <i>Lentinus</i> [(Scop.) Fr. 1836]	391	[483]
= <i>Agaricus pulverulentus</i> Scop. 1772		
<i>purvinatus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Pers.:Fr. 1801]	132	[173]
<i>pumilus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Pers.:Fr. 1801]	170	[226]
<i>punctatus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr.:Fr. 1828]	179	[239]
?= <i>Agaricus punctatus</i> Schaeff. 1774		
<i>punctatus</i> , <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Pers.) Fr. 1838, comb. nov.]	299	[382]
= <i>Agaricus punctatus</i> Pers. 1801, nom. illegit., non Schaeff. 1774, nec Fr.:Fr. 1828		
= <i>Agaricus gentilis</i> γ <i>punctatus</i> (Pers.:Fr.) Fr. 1821		
<i>puniceus</i> , <i>Hygrophorus</i> [(Fr.:Fr.) Fr. 1836]	331	[419]
= <i>Agaricus puniceus</i> Fr.:Fr. 1821		
<i>purifluus</i> , <i>Bolbitius</i> [(Lasch:Fr.) Fr. 1838, comb. nov.]	254	[335]
= <i>Agaricus purifluus</i> Lasch:Fr. 1828		
<i>purpurascens</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[Fr. 1838, nom. nov.]	265	[345]
= <i>Agaricus purpurascens</i> Fr. 1818, nom. illegit., non Scop. 1772, nec Alb. & Schwein.:Fr. 1805		
<i>purpurascens</i> , <i>Hygrophorus</i>		
[(Alb. & Schwein.:Fr.) Fr. 1838, comb. nov.]	322	[407]
= <i>Agaricus purpurascens</i> Alb. & Schwein.:Fr. 1805		
<i>purus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Pers.:Fr. 1794]	102	[133]
<i>pusiolus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1828]	195	[258]
= <i>Agaricus pusillus</i> Fr.:Fr. 1821, non (Pers.:Fr.) DC. 1805		
<i>pustulatus</i> , <i>Hygrophorus</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	325	[411]
= <i>Agaricus pustulatus</i> Pers.:Fr. 1801		

Taxon	Page	[Hym. Eur. page]
<i>putidus</i> , <i>Agaricus (Tricholoma)</i> [Fr. 1838, sp. nov.] . . .	54, (95)	[78, (125)]
<i>putillus</i> , <i>Marasmius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	377	[470]
= <i>Agaricus putillus</i> Fr.:Fr. 1818		
<i>pycnoticus</i> , <i>Panus</i> [(Klotzsch) Fr. 1838, comb. nov.]	397	[-]
= <i>Agaricus pycnoticus</i> Klotzsch 1833		
<i>pygmaeus</i> , <i>Agaricus (Naucoria)</i> [Bull.:Fr. 1791]	194	[256]
<i>pyramidalis</i> , <i>Marasmius</i> [(Scop.) Fr. 1838, comb. nov.] . . .	375	[468]
= <i>Agaricus pyramidalis</i> Scop. 1772		
<i>pyriodorus</i> , <i>Agaricus (Hebeloma)</i> [Pers.:Fr. 1801]	172	[228]
<i>pyrogalus</i> , <i>Lactarius</i> [(Bull.:Fr.) Fr. 1838, comb. nov.] . . .	339	[427]
= <i>Agaricus pyrogalus</i> Bull.Fr. 1792		
<i>pyxidatus</i> , <i>Agaricus (Omphalia)</i> [Bull. ex Pers.:Fr. 1801] . .	122	[157]

Q

<i>quadricolor</i> , <i>Cortinarius (Telamonia)</i>		
[(Scop.) Fr. 1838, comb. nov.]	295	[378]
= <i>Agaricus quadricolor</i> Scop. 1772		
<i>quietus</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	343	[431]
= <i>Agaricus quietus</i> Fr.:Fr. 1821		
<i>quinquepartitus</i> , <i>Agaricus (Tricholoma)</i> [L. 1753]	27	[49]

R

<i>racemosus</i> , <i>Agaricus (Collybia)</i> [Pers.:Fr. 1794]	90	[119]
= <i>Mycena racemosa</i> (Pers.:Fr.) Gray 1821		
<i>rachodes</i> , <i>Agaricus (Lepiota)</i> [Vittad. 1833]	13	[29 'rhacodes']
<i>radians</i> , <i>Coprinus</i> [(Desm.:Fr.) Fr. 1838, comb. nov.]	248	[326]
= <i>Agaricus radians</i> Desm.:Fr. 1828		
<i>radiatus</i> , <i>Coprinus</i> [(Bolton:Fr.) Pers. 1797]	251	[330]
= <i>Agaricus radiatus</i> Bolton:Fr. 1788		
<i>radicatus</i> , <i>Agaricus (Collybia)</i> [Relhan:Fr. 1786]	81	[109]
<i>radicosus</i> , <i>Agaricus (Pholiota)</i> [Bull.:Fr. 1783–84]	163	[218]
<i>raeborhizus</i> , <i>Agaricus (Mycena)</i> [Lasch:Fr. 1829]	105	[137]
<i>ramealis</i> , <i>Marasmius</i> [(Bull.:Fr.) Fr. 1838, comb. nov.]	381	[474]
= <i>Agaricus ramealis</i> Bull.:Fr. 1787–88		
<i>ramentaceus</i> , <i>Agaricus (Armillaria)</i> [Bull. ex Pers.:Fr. 1801] . .	21	[42]
<i>ramosus</i> , <i>Agaricus (Collybia)</i> [Bull.:Fr. 1782–83]	86	[115]
<i>rancidus</i> , <i>Agaricus (Collybia)</i> [Fr.:Fr. 1821]	95	[125]
<i>rapaceus</i> , <i>Cortinarius (Phlegmacium)</i> [Fr. 1838, sp. nov.] . .	263	[343]
<i>raphanoides</i> , <i>Cortinarius (Dermocybe)</i>		
[(Pers.:Fr.) Fr. 1838, comb. nov.]	290	[373]
= <i>Agaricus raphanoides</i> Pers.:Fr. 1801		
<i>rapidus</i> , <i>Coprinus</i> [Fr. 1838, sp. nov.]	253	[332]
<i>rasilis</i> , <i>Agaricus (Tricholoma)</i> [Fr. 1838, sp. nov.]	54	[77]
<i>ravida</i> , <i>Russula</i> [Fr. 1838, sp. nov.]	363	[454]
= <i>Agaricus pectinaceus</i> Bull. 1791, pro parte		

Taxon	Page	[Hym. Eur. page]
<i>ravidus</i> , <i>Agaricus</i> (<i>Galera</i>) [Fr.:Fr. 1818]	204	[271]
<i>rawakensis</i> , <i>Xerotus</i> [(Pers.) Fr. 1838, comb. nov.]	401	[-]
= <i>Agaricus rawakensis</i> Pers. 1827		
<i>reclinis</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr. 1838, sp. nov.]	127	[163]
<i>recutitus</i> , <i>Agaricus</i> (<i>Amanita</i>) [Fr. 1838, sp. nov.]	6	[19]
= <i>Agaricus bulbosus</i> Bull. 1793, pro parte, nom. illegit., non Schaeff. 1774, nec Sowerby:Fr. 1798–99		
<i>redimitus</i> , <i>Cortinarius</i> (<i>Inoloma</i>) <i>tofaceous</i> var.		
[Fr. 1838, var. nov.]	281	[363]
<i>reductus</i> , ? <i>Agaricus</i> (<i>Collybia</i>) [Fr.:Fr. 1818]	98	[262]
<i>reflexus</i> , <i>Agaricus</i> (<i>Pholiota</i>) <i>squarrosus</i> var.		
[(Pers.:Fr.) Fr. 1821]	166	[221]
= <i>Agaricus reflexus</i> Pers. 1801		
<i>regius</i> , <i>Agaricus</i> (<i>Volvaria</i>) [Fr. 1838, nom. nov.]	139	[(184)]
= <i>Hypophyllum cucullatum</i> Paulet ?1793		
<i>relicinus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr.:Fr. 1821]	171	[227]
<i>remotus</i> , <i>Agaricus</i> (<i>Panaeolus</i>) [Fr. 1838, sp. nov.]	235	[311]
<i>renidens</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.]	308	[392]
<i>reniformis</i> , <i>Lentinus</i> ? [(G.Mey.:Fr.) Fr. 1838, comb. nov.]	396	[-]
= <i>Agaricus reniformis</i> G.Mey.:Fr. 1818		
<i>repanda</i> [sic], <i>Lenzites</i> – See <i>repandus</i> , <i>Lenzites</i>		
<i>repandus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Bull.:Fr. 1789]	174	[231 sub <i>Agaricus fibrosus</i>]
<i>repandus</i> , <i>Lenzites</i> [(Pers.) Fr. 1838, comb. nov., ‘ <i>repanda</i> ’]	404	[-]
= <i>Daedalea repanda</i> Pers. 1827		
<i>repens</i> , <i>Agaricus</i> (<i>Collybia</i>) <i>platyphyllus</i> var.		
[(Fr.) Fr. 1838, nom. nov.]	82	[110]
= <i>Agaricus repens</i> Fr. 1815, nom. illegit., non Bull. 1781–82		
<i>replexus</i> , <i>Cantharellus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	367	[459]
= <i>Agaricus replexus</i> Fr.:Fr. 1821		
<i>resimus</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	336	[422]
= <i>Agaricus resimus</i> Fr.:Fr. 1821		
<i>resinaceus</i> , <i>Lentinus</i> <i>pulverulentus</i> var.		
[(Trog) Fr. 1838, comb. nov.]	391	[483]
= <i>Agaricus resinaceus</i> Trog 1832		
= <i>Lentinus resinaceus</i> (Trog) Fr. 1836		
<i>resutus</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Fr. 1838, sp. nov.]	145	[193]
<i>reticulatus</i> , <i>Agaricus</i> (<i>Galera</i>) [Pers.:Fr. 1798]	203	[266]
<i>retirugis</i> , <i>Agaricus</i> (<i>Panaeolus</i>) [Fr. 1838, sp. nov.]	235	[310]
= <i>Agaricus carbonarius</i> var. δ Batsch 1786		
<i>retirugis</i> , <i>Cantharellus</i> [(Bull.:Fr.) Fr. 1821, ‘ <i>retirugus</i> ’]	368	[460 ‘ <i>retirugus</i> ’]
= <i>Helvella retirugis</i> Bull.:Fr. 1791		
<i>retirugus</i> [sic], <i>Cantharellus</i> – See <i>retirugis</i> , <i>Cantharellus</i>		
<i>retostus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr. 1838, sp. nov.]	125	[161]
<i>rhagadiosus</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Fr.:Fr. 1821]	22	[44]
<i>rhodocalyx</i> [sic], <i>Agaricus</i> – See <i>rhodocylix</i> , <i>Agaricus</i>		

Taxon	Page	[Hym. Eur. page]
<i>rhodocylix</i> [' <i>rhodocalyx</i> '], <i>Agaricus</i> (<i>Eccilia</i>) [Lasch:Fr. 1829]	160	[213]
<i>rhodomelas</i>, <i>Agaricus</i> (<i>Volvaria</i>) <i>volvaceus</i> var. [(Lasch) Fr. 1838, comb. nov.]	138	[183 as <i>Agaricus rhodomelas</i>]
= <i>Agaricus rhodomelas</i> Lasch:Fr. 1829		
<i>rhodopoliis</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Fr.:Fr. 1818]	147	[195]
<i>rhytipus</i>, <i>Russula</i> [Secr. ex Fr. 1838, sp. nov.]	357	[445 ' <i>rhytipes</i> ']
= <i>Agaricus rhytipus</i> Secr. 1833, nom. inval.		
<i>riculatus</i>, <i>Cortinarius</i> (<i>Dermocybe</i>) [Fr. 1838, sp. nov.]	284	[366]
<i>riederi</i>, <i>Cortinarius</i> (<i>Phlegmacium</i>) [(Weinm. ex Fr.:Fr.) Fr. 1838, comb. nov.]	259	[339]
= <i>Agaricus riederi</i> Weinm. ex Fr.:Fr. 1828		
<i>rigens</i>, <i>Agaricus</i> (<i>Pluteus</i>) <i>cervinus</i> var. [(Pers.) Fr. 1838, comb. nov.]	140	[186]
= <i>Agaricus pluteus</i> β <i>A. rigens</i> Pers. 1801		
[The species name, <i>Agaricus cervinus</i> Schaeff. 1774, is unavailable, non Hoffm.:Fr. 1789]		
<i>rigens</i>, <i>Cortinarius</i> (<i>Hydrocybe</i>) [(Pers.) Fr. 1838, comb. nov.]	311	[395]
= <i>Agaricus rigens</i> Pers. 1801		
<i>rigidus</i>, <i>Cortinarius</i> (<i>Telamonina</i>) [(Scop.) Fr. 1838, comb. nov.]	302	[386]
= <i>Agaricus rigidus</i> Scop. 1772		
<i>rimosus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Bull.:Fr. 1789]	174	[232]
<i>ringens</i>, <i>Lentinus</i> [(Fr.:Fr.) Fr. 1836]	396	[490 as <i>Panus ringens</i>]
= <i>Agaricus ringens</i> Fr.:Fr. 1828		
<i>rivulosus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Pers.:Fr. 1801]	61	[86]
<i>robustus</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Alb. & Schwein.:Fr. 1805]	21	[41]
<i>romanus</i>, <i>Xerotus</i> [Fr. 1838, nom. nov.]	401	[491]
= <i>Merulius torulosus</i> Pers. 1825		
<i>roridus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1815]	117	[150]
<i>rosacea</i>, <i>Russula</i> [(Pers.) Fr. 1838, comb. nov.]	351	[442]
= <i>Russula rosea</i> Pers. 1796		
= <i>Agaricus Russula rosaceus</i> Pers. 1801		
<i>rosellus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1821]	101	[132]
<i>roseoalbus</i> , <i>Agaricus</i> (<i>Pluteus</i>) [Hornem.:Fr. 1819]	142	[188]
<i>roseus</i>, <i>Agaricus</i> (<i>Lepiota</i>) <i>clypeolarius</i> var. [(Scop.) Fr. 1838, comb. nov.]	15	[-]
= <i>Agaricus roseus</i> Scop.:Fr. 1772		
<i>roseus</i>, <i>Gomphidius glutinosus</i> var. [(Fr.:Fr.) Fr. 1838, comb. nov.]	319	[400]
= <i>Agaricus glutinosus</i> β <i>roseus</i> Fr.:Fr. 1821		
<i>rotula</i>, <i>Marasmius</i> [(Scop.:Fr.) Fr. 1838, comb. nov.]	385	[477]
= <i>Agaricus rotula</i> Scop.:Fr. 1772		
<i>rubellus</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Scop. 1772]	145	[192]
<i>rubescens</i> , <i>Agaricus</i> (<i>Amanita</i>) [(Pers.:Fr.) Fr. 1821]	7	[23]
= <i>Amanita rubescens</i> Pers.:Fr. 1797		
<i>rubiginosus</i> , <i>Agaricus</i> (<i>Galera</i>) [Pers. 1801]	206	[269]
= <i>Agaricus hypnorum</i> ε <i>A. rubiginosus</i> (Pers.:Fr.) Fr. 1821		

Taxon	Page	[Hym. Eur. page]
<i>rubra</i> , <i>Russula</i> [(Lam.:Fr.) Fr. 1838, comb. nov.]	354	[444]
= <i>Amanita rubra</i> Lam.:Fr. 1783		
= <i>Agaricus ruber</i> (Lam.:Fr.) DC. 1805		
<i>rubricosus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Fr.) Fr. 1838, comb. nov.]	310	[393]
= <i>Agaricus castaneus</i> e <i>rubricosus</i> Fr. 1818		
<i>rubromarginatus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1815]	101	[132]
<i>runderum</i> , <i>Agaricus</i> (<i>Galera</i>) [Bertero & Mont. 1837]	203	[-]
<i>rudis</i> , <i>Panus</i> [Fr. 1838, sp. nov.]	398	[489]
= <i>Agaricus hirtus</i> Secr. 1833, nom. inval. et illegit., non Fr.:Fr. 1830		
<i>rufescens</i> , <i>Cantharellus</i> [(Paulet) Fr. 1838, comb. nov.]	365	[456]
= <i>Hyponevris rufescens</i> Paulet ?1793		
<i>rufoolivaceus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Pers.:Fr.) Fr. 1838, comb. nov.]	268	[348]
= <i>Agaricus rufoolivaceus</i> Pers.:Fr. 1801		
<i>rufus</i> , <i>Lactarius</i> [(Scop.:Fr.) Fr. 1838, comb. nov.]	347	[433]
= <i>Agaricus rufus</i> Scop.:Fr. 1772		
<i>rugosus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr. 1838, sp. nov.]	106	[138]
= <i>Agaricus fistulosus</i> Bull. 1791, pro parte		
<i>rusiophyllus</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Lasch:Fr. 1828]	215 ['521']	[282]
<i>Russula</i> [Pers.:Fr. 1796]	349, 602	[9, 439]
<i>russula</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Schaeff.:Fr. 1774]	30	[52]
<i>russus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.]	261	[341]
<i>rusticus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr. 1838, nom. nov.]	124	[159]
= <i>Agaricus ericetorum</i> γγ <i>nigrogrisellus</i> Alb. & Schwein. 1805		
<i>rutilans</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Schaeff.:Fr. 1774]	30	[53]
S		
<i>saccharinus</i> , <i>Marasmius</i> [(Batsch:Fr.) Fr. 1838, comb. nov.]	386	[479]
= <i>Agaricus saccharinus</i> Batsch:Fr. 1786		
<i>saepiaria</i> [sic], <i>Lenzites</i> – See <i>sepiarius</i> , <i>Lenzites</i>		
<i>saevus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) <i>personatus</i> var.		
[Fr. 1838, var. nov.]	48	[-]
<i>sagatus</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Fr.:Fr. 1821]	214	[281]
<i>saginus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	260	[340]
= <i>Agaricus saginus</i> Fr.:Fr. 1821		
<i>sajor-caju</i> , <i>Lentinus</i> [(Rumph. ex Fr.:Fr.) Fr. 1825]	393	[-]
= <i>Agaricus sajor-caju</i> Rumph. ex Fr.:Fr. 1821		
<i>salicinus</i> , <i>Agaricus</i> (<i>Pluteus</i>) [Pers.:Fr. 1798]	141	[186]
<i>salignus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Pers.:Fr. 1801]	133	[174]
<i>salor</i> , <i>Cortinarius</i> (<i>Myxaciium</i>) [Fr. 1838, sp. nov.]	276	[357]
<i>sambucinus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr.:Fr. 1821]	175	[234]
<i>sandicinus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [(Fr.) Fr. 1838, comb. nov.] 79[bis]		[108]
= <i>Agaricus demissus</i> β <i>sandicinus</i> Fr.:Fr. 1821		

Taxon	Page	[Hym. Eur. page]
<i>sanguifluus</i> , <i>Lactarius</i> [(Paulet) Fr. 1838, comb. nov.]	341	[431]
= <i>Hypophyllum sanguifluum</i> Paulet ?1793		
<i>sanguinea</i> , <i>Russula</i> [(Bull.) Fr. 1838, comb. nov.]	351	[442]
= <i>Agaricus sanguineus</i> Bull. 1780–81, non Wulfen:Fr. 1781		
<i>sanguineus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>)		
[(Wulfen:Fr.) Fr. 1838, comb. nov.]	288	[370]
= <i>Agaricus sanguineus</i> Wulfen:Fr. 1781		
<i>sanguinolentus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Alb. & Schwein.:Fr. 1805]	115	[148]
<i>saniosus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	313	[397]
= <i>Agaricus saniosus</i> Fr.:Fr. 1821		
<i>sapineus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr.:Fr. 1821]	189	[251]
<i>saponaceus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1818]	35	[59]
<i>sarcitus</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Fr. 1838, sp. nov.]	155	[205]
<i>sarcocephalus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Fr. 1815]	228	[297 'non Ed. I']
= <i>Agaricus compactus</i> β <i>A. sarcocephalus</i> (Fr.:Fr.) Fr. 1821		
<i>sardellus</i> , † <i>Agaricus</i> (<i>Psilocybe</i>) [Fr. 1838, nom. nov.]	230	[319]
= <i>Agaricus montanus</i> γγ <i>coriarius</i> Alb. & Schwein. 1805		
<i>sardonias</i> , <i>Russula</i> [Fr. 1838, sp. nov.]	353	[442]
= <i>Agaricus emeticus</i> Schaeff. 1774, pro parte		
<i>saturninus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	306	[390]
= <i>Agaricus saturninus</i> Fr.:Fr. 1821		
<i>saxatilis</i> , <i>Marasmius</i> [Fr. 1838, sp. nov.]	378	[471]
<i>scabellus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Alb. & Schwein.:Fr. 1805] . . .	177	[235]
<i>scaber</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [O.F.Müll.:Fr. 1780]	172	[228]
<i>scabiosus</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Fr. 1836]	145	[193]
<i>scabrosus</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Fr. 1838, sp. nov.]	154	[205]
<i>scalaris</i> , <i>Agaricus</i> (<i>Crepidotus</i>) [Fr. 1838, sp. nov.]	211	[276]
= <i>Agaricus mollis</i> sensu Alb. & Schwein. 1805, non Schaeff.:Fr. 1774		
<i>scalpturatus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, nom. nov.] . . .	31	[55]
= <i>Agaricus flavorufus</i> Pers. 1828		
<i>scambus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr.:Fr. 1818]	184	[253]
<i>scandens</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.]	312	[396]
<i>scaurus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	268	[349]
= <i>Agaricus scaurus</i> Fr.:Fr. 1818		
<i>sceptrum</i> , <i>Coprinus</i> [(Jungh.) Fr. 1838, comb. nov.]	253	[332]
= <i>Agaricus sceptrum</i> Jungh. 1830		
<i>Schizophyllum</i> [Fr.:Fr. 1815]	402, 602	[10, 492]
<i>schizopus</i> , <i>Marasmius</i> ? [Fr. 1838, sp. nov.]	384	[476]
= <i>Agaricus schistopus</i> Secr. 1833, nom. inval.		
<i>schumacheri</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1818]	45	[69]
<i>schweinitzii</i> ['schweinitzii'], <i>Lentinus</i> [Fr.:Fr. 1825]	388	[-]
= <i>Agaricus denticulatus</i> Schwein. 1822, nom. illegit., non Schumach.:Fr. 1803		

Taxon	Page	[Hym. Eur. page]
schweinizzii [sic], <i>Lentinus</i> – See <i>schweinitzii</i> , <i>Lentinus</i>		
<i>sciophanus</i> , <i>Hygrophorus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.] . . .	329	[417]
= <i>Agaricus sciophanus</i> Fr.:Fr. 1821		
<i>scleropus</i> , <i>Lentinus</i> [(Pers.) Fr. 1836]	392	[-]
= <i>Agaricus scleropus</i> Pers. 1827		
<i>scobinaceus</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Fr. 1838, sp. nov.]	217	[288]
= <i>Agaricus gunneri</i> Secr. 1833, nom. inval. et illegit., non Fr.:Fr. 1821		
<i>scobinellus</i> , <i>Agaricus</i> (<i>Amanita</i>) [Fr. 1838, sp. nov.]	11	[26]
<i>scolecinus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1838, sp. nov.]	194	[258]
<i>scorodonius</i> , <i>Marasmius</i> [(Fr.:Fr.) Fr. 1836]	379	[472]
= <i>Agaricus scorodonius</i> Fr.:Fr. 1815		
<i>scorpioides</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1838, sp. nov.]	199	[262]
<i>scorteus</i> , <i>Marasmius</i> [Fr. 1838, sp. nov.]	376	[468]
<i>scorzonerus</i> , <i>Agaricus</i> (<i>Collybia</i>) <i>maculatus</i> var.		
[Fr. 1838, nom. nov.]	84	[113 ‘ <i>scorzonerus</i> ’]
= <i>Agaricus mollis</i> Batsch 1783, nom. illegit., non Schaeff.:Fr. 1774		
<i>scrobiculatus</i> , <i>Lactarius</i> [(Scop.:Fr.) Fr. 1838, comb. nov.] . . .	334	[422]
= <i>Agaricus scrobiculatus</i> Scop.:Fr. 1772		
<i>scruposus</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Fr. 1838, nom. nov.]	22	[42]
= <i>Hypophyllum scriblita</i> Paulet ?1793		
<i>scutulatus</i> , <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	294	[377]
= <i>Agaricus scutulatus</i> Fr.:Fr. 1821		
<i>scyphiformis</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr. 1818]	124	[159]
<i>scyphoides</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr.:Fr. 1821]	122	[156]
<i>sebaceus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.] . .	258	[337]
secretani [sic], <i>Agaricus</i> – See <i>secretanii</i> , <i>Agaricus</i>		
<i>secretanii</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr. 1838, sp. nov., ‘ <i>secretani</i> ’] .	161	[215 ‘ <i>secretani</i> ’]
= <i>Agaricus muricatus</i> Secr. 1833, nom. inval. et illegit., non Fr.:Fr. 1821		
<i>segestrius</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1818]	202	[265]
<i>sejunctus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Sowerby:Fr. 1798–99]	26	[48]
<i>semibulbosus</i> , <i>Agaricus</i> (<i>Pluteus</i>) [Lasch ex Fr. 1838, sp. nov.]	141	[188]
<i>semicrema</i> , <i>Russula</i> [Fr. 1838, sp. nov.]	350	[440]
<i>semiglobatus</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Batsch:Fr. 1786]	220	[287]
<i>semilanceatus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Fr. 1818]	231	[301]
<i>seminudus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Lasch 1828]	18	[38]
<i>semiorbicularis</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Bull. 1789]	197	[260]
<i>semitalis</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr.:Fr. 1821]	82	[110]
<i>separatus</i> , <i>Agaricus</i> (<i>Panaeolus</i>) [L. 1753]	234	[310]
<i>sepiarius</i> , <i>Lenzites</i> [(Wulfen:Fr.) Fr. 1838, comb. nov., ‘ <i>saepiaria</i> ’]	407	[494 ‘ <i>saepiaria</i> ’]
= <i>Agaricus sepiarius</i> Wulfen:Fr. 1787		
= <i>Merulius sepiarius</i> (Wulfen:Fr.) Schrank 1789		
= <i>Daedalea sepiaria</i> (Wulfen:Fr.) Sw. 1810		
<i>septicus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr.:Fr. 1821]	136	[179]
<i>serarius</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.] . . .	269	[350]

Taxon	Page	[Hym. Eur. page]
<i>sericellus</i> , <i>Agaricus</i> (<i>Entoloma</i>) [(Fr.:Fr.) Fr. 1821]	146	[194]
= <i>Agaricus sericeus</i> β <i>sericellus</i> Fr. 1818		
<i>sericeus</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Bull. 1789]	147	[196]
nom. illegit., non <i>Agaricus sericeus</i> Schaeff. 1774		
<i>sericeus</i> , [†] <i>Agaricus</i> (<i>Entoloma</i>) [Pers. 1798]	146	[194 sub <i>Agaricus</i>
nom. illegit., non <i>Agaricus sericeus</i> Schaeff. 1774		<i>sericellus</i>]
= <i>Agaricus sericellus</i> β <i>A. sericeus</i> [(Pers.:Fr.) Fr. 1821]		
<i>serifluus</i> , <i>Lactarius</i> [(DC.:Fr.) Fr. 1838, comb. nov.]	345	[436]
= <i>Agaricus serifluus</i> DC.:Fr. 1815		
<i>serotinus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Pers.:Fr. 1793]	135	[176]
<i>serrulatus</i> , <i>Agaricus</i> (<i>Leptonia</i>) [Fr.:Fr. 1818]	153	[203]
<i>setiger</i> , <i>Agaricus</i> (<i>Psalliota</i>) [(Paulet) Fr. 1838, comb. nov.] . .	214	[281]
= <i>Hypophyllum setigerum</i> Paulet ?1793		
<i>setipes</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr.:Fr. 1818]	127	[164]
<i>setisedus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Schwein.:Fr. 1822]	73	[-]
<i>setosus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Sowerby 1800–03]	119	[153]
<i>siccus</i> , <i>Marasmius</i> [(Schwein.:Fr.) Fr. 1838, comb. nov.]	382	[-]
= <i>Agaricus siccus</i> Schwein.:Fr. 1822		
<i>sideroides</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Bull. 1793]	196	[258]
<i>silaceus</i> , <i>Agaricus</i> (<i>Hypholoma</i>) [Pers. 1801]	221	[290]
<i>siligineus</i> , <i>Agaricus</i> (<i>Galera</i>) [Fr. 1818]	205	[267]
= <i>Agaricus tener</i> δ <i>A. siligineus</i> (Fr.:Fr.) Fr. 1821		
<i>silvaticus</i> [sic], <i>Agaricus</i> – See <i>sylvaticus</i> , <i>Agaricus</i>		
<i>silvicola</i> [sic], <i>Agaricus campestris</i> – See <i>sylvicola</i> , <i>Agaricus campestris</i>		
<i>sinapizans</i> , <i>Agaricus</i> (<i>Hebeloma</i>)		
[(Paulet) Fr. 1838, comb. nov.]	180	[240]
= <i>Hypophyllum sinapizans</i> Paulet ?1793		
<i>sindonius</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr. 1838, sp. nov.]	176	[234]
<i>sinopicus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1818]	69	[95]
<i>sinuatus</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Pers.:Fr. 1801]	143	[189]
<i>sinuosus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr. 1838, sp. nov.]	178	[237]
= <i>Agaricus sinu� Bull. 1793</i> [non <i>Agaricus repandus</i> Bull.:Fr. 1789]		
<i>siparius</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1821]	201	[263]
<i>sistratus</i> , <i>Agaricus</i> (<i>Lepiota</i>) [Fr.:Fr. 1821]	18	[37]
<i>sitaneus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, nom. nov.]	82	[110 sub <i>Agaricus</i>
= <i>Agaricus elevatus</i> Weinm. 1835		<i>elevatus</i>]
<i>sitaneus</i> , <i>Lentinus</i> [Fr. 1836]	390	[482]
<i>sobolewskii</i> , <i>Agaricus</i> (<i>Collybia</i>) [Weinm. 1836]	87	[117]
<i>sobolifer</i> , <i>Coprinus</i> [(Hoffm.) Fr. 1838, comb. nov., ‘ <i>soboliferus</i> ’]	243	[322]
= <i>Agaricus sobolifer</i> Hoffm. 1789		
<i>soboliferus</i> [sic], <i>Coprinus</i> – See <i>sobolifer</i> , <i>Coprinus</i>		
<i>sobrius</i> , <i>Agaricus</i> (<i>Naucoria</i>) [(Fr.) Fr. 1838, comb. nov.] . . .	200	[263]
= <i>Agaricus furfuraceus</i> γ <i>sobrius</i> Fr. 1818		
= <i>Agaricus sobrius</i> (Fr.) Secr. 1833, nom. inval.		
<i>socialis</i> , <i>Agaricus</i> (<i>Flammula</i>) [DC.:Fr. 1815]	191	[111 sub <i>Agaricus</i>
		<i>tabescens</i>]

Taxon	Page	[Hym. Eur. page]
<i>sociatus</i> , <i>Coprinus</i> [(Schumach.:Fr.) Fr. 1838, comb. nov.]	252	[331]
= <i>Agaricus sociatus</i> Schumach.:Fr. 1803		
<i>solifugus</i> , <i>Coprinus</i> [(L.Marchand) Fr. 1838, comb. nov.]	253	[333]
= <i>Agaricus solifugus</i> L.Marchand 1826–30		
<i>solitarius</i> , <i>Agaricus</i> (<i>Amanita</i>) [Bull.:Fr. 1780–81]	6	[22]
= <i>Amanita solitaria</i> (Bull.:Fr.) Fr. 1836		
<i>solstitialis</i> , <i>Agaricus</i> (<i>Leptonia</i>) <i>aethiops</i> var. [Fr. 1838, var. nov.]	152	[202 as <i>Agaricus solstitialis</i>]
<i>sordarius</i> , <i>Paxillus</i> [(Pers.) Fr. 1838, comb. nov.]	316	[401]
= <i>Agaricus sordarius</i> Pers. 1801		
<i>sordidus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Schumach.:Fr. 1803]	53	[77]
<i>sororia</i> , <i>Russula consobrina</i> var. [Fr. 1838, var. nov.]	359	[447]
<i>spadiceogriseus</i> , <i>Agaricus</i> (<i>Psathyra</i>) [Schaeff. 1774]	232	[306]
<i>spadiceus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Schaeff. 1774]	225	[302]
nom. illegit., non <i>Agaricus spadiceus</i> Scop. 1772		
<i>spadiceus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, nom. nov.]	261	[339]
= <i>Agaricus spadiceus</i> Batsch 1783, nom. illegit., non Scop. 1772, nec Schaeff. 1774		
<i>spadiceus</i> , <i>Hygrophorus</i> [(Scop.) Fr. 1838, comb. nov.]	332	[420]
= <i>Agaricus spadiceus</i> Scop. 1772		
<i>sparteus</i> , <i>Agaricus</i> (<i>Galera</i>) [Fr.:Fr. 1821]	206	[269]
<i>spathulatus</i> , <i>Cantharellus</i> [Fr.:Fr. 1828]	368	[460]
<i>speciosus</i> , <i>Agaricus</i> (<i>Volvaria</i>) [(Fr.:Fr.) Fr. 1821]	139	[183]
= <i>Amanita speciosa</i> Fr.:Fr. 1818		
= <i>Pluteus speciosus</i> (Fr.:Fr.) Fr. 1836		
<i>spectabilis</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr.:Fr. 1828]	166	[221]
<i>speculum</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Fr. 1836]	148	[197]
<i>speireus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1815]	113	[147]
<i>spermaticus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [(Paulet) Fr. 1838, comb. nov.]	27	[49]
= <i>Hypophyllum spermaticum</i> Paulet ?1793		
<i>sphagnorum</i> , <i>Agaricus</i> (<i>Galera</i>) <i>hypnorum</i> var. [Pers.:Fr. 1801]	207	[270]
<i>sphaleromorphus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Bull. ex Pers.:Fr. 1801]	163	[217]
<i>sphinctrinus</i> , <i>Agaricus</i> (<i>Panaeolus</i>) [Fr. 1838, sp. nov.]	235	[311]
= <i>Agaricus fimiputris</i> sensu Weinm. 1833, non Bull.:Fr. 1781–82		
<i>sphlachnoides</i> [sic], <i>Marasmius</i> – See <i>splachnoides</i> , <i>Marasmius</i>		
<i>spiculus</i> , <i>Agaricus</i> (<i>Galera</i>) [Lasch:Fr. 1829]	206	[268]
<i>spilomaeolus</i> , <i>Paxillus sordarius</i> var. [Fr. 1838, var. nov.]	317	[402 as <i>Paxillus panaeolus</i> * <i>spilomaeolus</i>]
<i>spilomeus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>) [(Fr.:Fr.) Fr. 1838, comb. nov.]	287	[369]
= <i>Agaricus spilomeus</i> Fr.:Fr. 1818		
<i>spintriger</i> , <i>Agaricus</i> (<i>Psalliota</i>) [Fr. 1838, sp. nov.]	217	[289]
<i>spissus</i> , <i>Agaricus</i> (<i>Amanita</i>) [Fr. 1838, nom. nov.]	9	[23]
= <i>Agaricus cinereus</i> Krombh. 1831, nom. illegit., non Schaeff.:Fr. 1774		
= <i>Amanita cinerea</i> Krombh. 1836, nom. illegit., non Lam 1783		

Taxon	Page	[Hym. Eur. page]
<i>splachnoides</i>, <i>Marasmius</i>		
[(Hornem.:Fr.) Fr. 1838, comb. nov., 'splachnoides']	384	[478 'splachnoides']
= <i>Agaricus splachnoides</i> Hornem.:Fr. 1819		
<i>splendens</i>, <i>Agaricus</i> (<i>Clitocybe</i>) <i>gilvus</i> var.		
[(Pers.) Fr. 1838, comb. nov.]	70	[96 as <i>Agaricus splendens</i>]
= <i>Agaricus splendens</i> Pers.:Fr. 1801		
<i>spodoleucus</i>, <i>Agaricus</i> (<i>Pleurotus</i>) [Fr.:Fr. 1815]	133	[172]
<i>spodophyllus</i>, <i>Agaricus</i> (<i>Psalliota</i>) [Krombh. 1836]	214	[279 sub <i>Agaricus pratensis</i>]
<i>spoliatus</i>, <i>Agaricus</i> (<i>Hebeloma</i>) [Fr. 1838, sp. nov.]	182	[243]
<i>spongiosus</i>, <i>Agaricus</i> (<i>Pleurotus</i>) [Fr. 1838, sp. nov.]	130	[167]
<i>spumosus</i>, <i>Agaricus</i> (<i>Flammula</i>) [Fr.:Fr. 1821]	185	[247]
<i>squalens</i>, <i>Agaricus</i> (<i>Psilocybe</i>) [Fr. 1838, nom. nov.]	226	[303]
= <i>Agaricus planus</i> Sowerby 1800–03, non Fr.:Fr. 1828		
<i>squalidus</i>, <i>Hygrophorus</i> [(Lasch:Fr.) Fr. 1838, comb. nov.] . . .	332	[420]
= <i>Agaricus squalidus</i> Lasch:Fr. 1828		
<i>squamosus</i>, <i>Agaricus</i> (<i>Psalliota</i>) [Pers.:Fr. 1801]	219	[285]
<i>squamulosus</i>, <i>Agaricus</i> (<i>Clitocybe</i>) [Pers.:Fr. 1801]	68	[94]
<i>squarrosus</i>, <i>Agaricus</i> (<i>Pholiota</i>) [Vahl:Fr. 1770]	165	[221]
<i>stabilis</i>, <i>Agaricus</i> (<i>Flammula</i>) [Weinm. 1836]	188	[250]
<i>stagninus</i>, <i>Agaricus</i> (<i>Galera</i>) [Fr.:Fr. 1821]	209	[273]
<i>stanneus</i>, <i>Agaricus</i> (<i>Mycena</i>) [Fr. 1838, nom. nov.]	111	[143]
= <i>Agaricus griseus</i> Pers. 1828, nom. illegit., non Fr.:Fr. 1821, nec <i>Agaricus Russula griseus</i> Pers. 1801		
<i>stellatus</i>, <i>Agaricus</i> (<i>Omphalia</i>) [Fr.:Fr. 1815]	125	[162]
<i>stemmatus</i>, <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.] . . .	309	[385]
<i>stercorarius</i>, <i>Agaricus</i> (<i>Psalliota</i>) [Schumach.:Fr. 1803]	220	[287]
<i>stercoreus</i>, <i>Coprinus</i> [Fr. 1838, nom. nov.]	251	[330 as <i>Coprinus stercorarius</i>]
= <i>Agaricus stercorarius</i> Scop. 1772, non Schumach.:Fr. 1803		
<i>sterilis</i>, <i>Agaricus</i> (<i>Hebeloma</i>) [Jungh. 1830]	182	[243]
<i>sterquilinus</i>, <i>Coprinus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	242	[321]
= <i>Agaricus sterquilinus</i> Fr.:Fr. 1821		
<i>sticticus</i>, <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1835]	195	[259]
<i>stillatitius</i>, <i>Cortinarius</i> (<i>Myxaciium</i>) [Fr. 1838, sp. nov.] . . .	277	[358]
<i>stipitarius</i>, <i>Agaricus</i> (<i>Collybia</i>) [Fr.:Fr. 1821]	87	[116]
<i>stipticus</i> [sic], <i>Panus</i> – See <i>stypticus</i> , <i>Panus</i>		
<i>stipularis</i>, <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1821]	119	[154]
<i>stolonifer</i>, <i>Agaricus</i> (<i>Collybia</i>) [Jungh. 1830]	92	[121 as <i>Agaricus tenacellus</i> * <i>stolonifer</i>]
<i>storea</i>, <i>Agaricus</i> (<i>Hypholoma</i>) [Fr. 1838, sp. nov.]	223	[293]
<i>stramineus</i>, <i>Agaricus</i> (<i>Armillaria</i>) [Krombh. 1836]	21	[41 sub <i>Agaricus luteovirens</i>]
nom. illegit., non <i>Agaricus stramineus</i> Scop. 1772		
<i>strangulatus</i>, <i>Agaricus</i> (<i>Amanita</i>) <i>solitarius</i> var.		
[Fr. 1838, var. nov.]	6	[27 as <i>Agaricus strangulatus</i>]
<i>streptopus</i>, <i>Hygrophorus</i> [Fr. 1838, sp. nov.]	328	[415]
= <i>Agaricus sinensis longipes</i> Secr. 1833, nom. inval.		

Taxon	Page	[Hym. Eur. page]
<i>striata</i> [sic], <i>Lenzites</i> – See <i>striatus</i> , <i>Lenzites</i>		
<i>striatulus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Pers.:Fr. 1801]	137	[181]
<i>striatus</i>, <i>Lenzites</i> [(Fr.:Fr.) Fr. 1838, comb. nov., ‘ <i>striata</i> ’]	406	[–]
= <i>Agaricus striatus</i> Sw. 1788, nom. illegit., non Schaeff. 1774, nec Bull.:Fr. 1792		
= <i>Daedalea striata</i> Fr.:Fr. 1821		
<i>strictus</i> , <i>Agaricus</i> (<i>Psathyra</i>) [Trog 1832]	232	[305]
nom. illegit., non <i>Agaricus Coprinus strictus</i> Pers. 1801		
<i>stridulus</i>, <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	85	[114]
<i>strigiceps</i> , <i>Agaricus</i> (<i>Flammula</i>) [Fr.:Fr. 1821]	183	[236]
<i>strigosus</i> , <i>Lentinus</i> [(Schwein.:Fr.) Fr. 1825]	388	[–]
= <i>Agaricus strigosus</i> Schwein.:Fr. 1822		
<i>strobiliformis</i> , <i>Agaricus</i> (<i>Amanita</i>) [Vittad. 1835]	5	[21]
<i>strobilinus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Pers.:Fr. 1801]	101	[132]
= <i>Mycena strobolina</i> (Pers.:Fr.) Gray 1821		
<i>strophosus</i>, <i>Agaricus</i> (<i>Pholiota</i>) [Fr. 1838, sp. nov.]	161	[240]
<i>strumosus</i>, <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, sp. nov.]	86	[115]
<i>stupens</i> [‘ <i>stuppeus</i> ’], <i>Lentinus</i> [Klotzsch 1833]	388	[–]
[The mistranscribed epithet ‘ <i>stuppeus</i> ’ first appeared in Fries 1836, Syn. Gen. Lent.: 6, where it was attributed solely to Klotzsch.]		
<i>stuppeus</i> [sic], <i>Lentinus</i> – See <i>stupens</i> , <i>Lentinus</i>		
<i>stygius</i> , <i>Agaricus</i> (<i>Clitocybe</i>) <i>difformis</i> var. [Fr.:Fr. 1821]	80	[106]
<i>stygius</i>, <i>Agaricus</i> (<i>Galera</i>) <i>paludosus</i> var. [Fr. 1838, var. nov.]	209	[273 sub <i>Agaricus paludosus</i>]
<i>Stylobates</i> [Fr. 1837]	370, 601	[–]
<i>stylobates</i> , <i>Agaricus</i> (<i>Mycena</i>) [Pers.:Fr. 1801]	117	[150]
<i>stypticus</i>, <i>Panus</i> [(Bull.:Fr.) Fr. 1838, comb. nov., ‘ <i>stipticus</i> ’]	399	[489 ‘ <i>stipticus</i> ’]
= <i>Agaricus stypticus</i> Bull.:Fr. 1783		
<i>suaveolens</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Schumach.:Fr. 1803]	76	[102]
<i>suavissimus</i> , <i>Lentinus</i> [Fr. 1836]	394	[486]
<i>subalutaceus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Batsch:Fr. 1789]	60	[84]
<i>subatratus</i> , <i>Agaricus</i> (<i>Psathyrella</i>) [Batsch 1786]	238	[313]
<i>subcavus</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Schumach.:Fr. 1803]	24	[46]
<i>subdulcis</i> , <i>Lactarius</i> [(Pers.:Fr.) Gray 1821]	345	[437]
= <i>Agaricus Lactifluus subdulcis</i> Pers.:Fr. 1801		
<i>subferrugineus</i>, <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Batsch:Fr.) Fr. 1838, comb. nov.]	303	[387]
= <i>Agaricus subferrugineus</i> Batsch:Fr. 1789		
<i>subgibbosus</i>, <i>Agaricus</i> (<i>Psalliota</i>) <i>comtulus</i> var.		
[Fr. 1838, var. nov.]	215 [‘521’]	[281]
<i>subglobosus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Alb. & Schwein.:Fr. 1805]	192	[254]
[In Fries’s sanctioning works, he attributed this name to Alb. & Schwein., but repeatedly and inconsistently mistranscribed the epithet, as ‘ <i>semiglobatus</i> A. S. p. 169’ (Fries 1821, p. 237) and as ‘ <i>semiglobosus</i> A. S.’ (Fries 1821, p. 513; 1832, p. 41).]		
<i>sublanatus</i>, <i>Cortinarius</i> (<i>Inoloma</i>)		
[(Sowerby:Fr.) Fr. 1838, comb. nov.]	283	[364]
= <i>Agaricus sublanatus</i> Sowerby:Fr. 1798–99		

Taxon	Page	[Hym. Eur. page]
<i>sublateritius</i> , <i>Agaricus</i> (<i>Hypholoma</i>) [Fr. 1838, nom. nov.] . . . 221	[290]	
= <i>Agaricus lateritius</i> Schaeff.:Fr. 1774		
<i>subliquescent</i> , <i>Agaricus</i> (<i>Psathyra</i>) [Schumach.:Fr. 1803] . . . 232	[305]	
<i>subluteus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Vahl:Fr. 1797] 168	[224]	
<i>subnotatus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>) [Fr. 1838, nom. nov.] . . 290	[372]	
= <i>Agaricus notatus</i> Pers. 1801		
<i>subpalmatus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr. 1838, sp. nov.] 131	[168]	
= <i>Agaricus palmatus</i> sensu Sowerby 1796–97, non Bull.:Fr. 1785		
<i>subpulverulentus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Pers. 1828] 52	[76]	
<i>subpurpurascens</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) <i>purpurascens</i> var. [(Batsch) Fr. 1838, comb. nov.] 265	[346]	
= <i>Agaricus subpurpurascens</i> Batsch 1786		
<i>subradiatus</i> , <i>Hygrophorus</i> [(Schumach.) Fr. 1838, comb. nov.] 328	[416]	
= <i>Agaricus subradiatus</i> Schumach. 1803		
<i>substriata</i> [sic], <i>Russula integra</i> – See <i>substriata</i> , <i>Russula integra</i>		
<i>substriata</i> , <i>Russula integra</i> var. [(Pers.) Fr. 1838, comb. nov., ‘ <i>substriata</i> ’] 360	[451 ‘ <i>substriata</i> ’]	
= <i>Agaricus alutaceus</i> β <i>substriatus</i> Pers. 1801		
= <i>Agaricus substriatus</i> (Pers.) Secr. 1833, nom. inval.		
<i>subtilis</i> , <i>Agaricus</i> (<i>Psathyrella</i>) [Fr.:Fr. 1821] 240	[316]	
<i>subtortus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [(Pers.:Fr.) Fr. 1838, comb. nov.] 273	[342]	
= <i>Agaricus subtortus</i> Pers.:Fr. 1801		
<i>subzonatus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Weinm. 1836] 182	[242]	
<i>succineus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr. 1838, nom. nov.] 91	[120]	
= <i>Agaricus melleus</i> Schaeff. 1774, non Vahl:Fr. 1790		
<i>sudorus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr. 1838, sp. nov.] 106	[138]	
<i>sudus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.] 38	[61]	
<i>suffrutescens</i> [‘ <i>suffrutescens</i> ’], <i>Lentinus</i> [(Brot.:Fr.) Fr. 1825] . . . 393	[484]	
= <i>Agaricus suffrutescens</i> Brot.:Fr. 1805		
<i>suffrutescens</i> [sic], <i>Lentinus</i> – See <i>suffrutescens</i> , <i>Lentinus</i>		
<i>suillus</i> , <i>Cortinarius</i> (<i>Inoloma</i>) [Fr. 1838, sp. nov.] 281	[362]	
<i>sulfureus</i> [sic], <i>Agaricus</i> – See <i>sulfureus</i> , <i>Agaricus</i>		
<i>sulfureus</i> [‘ <i>sulfureus</i> ’], <i>Agaricus</i> (<i>Tricholoma</i>) [Bull.:Fr. 1783–84] 40	[63]	
<i>supinus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1821] 113	[147]	
<i>suratus</i> , † <i>Cortinarius</i> (<i>Myxaciium</i>) [Fr. 1838, sp. nov.] . . . 275	[356]	
= <i>Agaricus spilomeus</i> Secr. 1833, nom. inval. et illegit., non Fr.:Fr. 1818		
<i>sylvaticus</i> [‘ <i>sylvaticus</i> ’], <i>Agaricus</i> (<i>Psalliota</i>) [Schaeff. 1774] . . . 214	[280 ‘ <i>sylvaticus</i> ’]	
<i>sylvicola</i> [‘ <i>sylvicola</i> ’], <i>Agaricus</i> (<i>Psalliota</i>) <i>campestris</i> var. [Vittad. 1835] 213	[280 ‘ <i>sylvicola</i> ’]	
<i>synodicus</i> , <i>Marasmius</i> [(Kunze:Fr.) Fr. 1838, comb. nov.] . . . 381	[–]	
= <i>Agaricus synodicus</i> Kunze:Fr. 1830		

Taxon	Page	[Hym. Eur. page]
T		
<i>tabacinus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [DC. 1815]	198	[261]
<i>tabescens</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Scop. 1772]	33	[111, 319, 704]
<i>tabidus</i> , <i>Lactarius</i> [Fr. 1838, sp. nov.]	346	[438]
= <i>Agaricus subdulcis</i> Pers.:Fr. 1801, pro parte		
<i>tabularis</i> , <i>Cortinarius</i> (<i>Dermocybe</i>)		
[(Fr.) Fr. 1838, comb. nov.]	284	[366]
= <i>Agaricus anomalus</i> γ <i>A. tabularis</i> Fr.:Fr. 1821		
<i>talus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, sp. nov.]	263	[344]
<i>tegelaris</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Schumach.:Fr. 1803]	230	[301]
<i>Telamonina</i> , <i>Cortinarius</i> “trib”		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	291, 601	[8, 374]
= <i>Agaricus trib. Telamonia</i> Fr.:Fr. 1821		
<i>temulentus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1821]	199	[262]
<i>tenacellus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Pers.:Fr. 1794]	92	[121]
<i>tenax</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1815]	198	[261]
<i>tenellus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Schumach. 1803]	111	[147]
<i>tenellus</i> , <i>Cantharellus</i> [(DC.:Fr.) Fr. 1821]	369	[462 as <i>Arrhenia tenella</i>]
= <i>Merulius tenellus</i> DC.:Fr. 1805		
<i>tener</i> , <i>Agaricus</i> (<i>Galera</i>) [Schaeff.:Fr. 1774]	204	[267]
= <i>Mycena tenera</i> (Schaeff.:Fr.) Gray 1821		
<i>tener</i> , <i>Lentinus</i> [Klotzsch ex Fr. 1836]	389	[-]
<i>tenuis</i> , <i>Agaricus</i> (<i>Mycena</i>) [Bolton 1788]	111	[143]
<i>tenuissimus</i> , <i>Agaricus</i> (<i>Galera</i>) [Weinm. 1836]	208	[271]
nom. illegit., non <i>Agaricus tenuissimus</i> Schwein.:Fr. 1822		
<i>tenuissimus</i> , <i>Lentinus</i> [(Schwein.) Fr. 1836]	396	[-]
= <i>Agaricus tenuissimus</i> Schwein. 1822		
= <i>Agaricus ringens</i> β <i>tenuissimus</i> (Schwein.:Fr.) Fr. 1828		
<i>tephroleucus</i> , <i>Hygrophorus</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	325	[411]
= <i>Agaricus tephroleucus</i> Pers.:Fr. 1801		
<i>tephrotrichus</i> , <i>Agaricus</i> (<i>Pleurotus</i>) <i>corticatus</i> var.		
[(Fr.) Fr. 1838, comb. nov.]	129	[166]
= <i>Agaricus torulosus</i> β <i>tephrotrichus</i> Fr. 1815		
= <i>Agaricus corticatus</i> [?forma] b. <i>tephrotrichus</i> (Fr.) Fr. 1821		
<i>terebratus</i> , <i>Hygrophorus pustulatus</i> var. [Fr. 1838, var. nov.]	325	[411]
<i>terginus</i> , <i>Marasmius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	377	[469]
= <i>Agaricus terginus</i> Fr.:Fr. 1821		
<i>tergiversans</i> , <i>Coprinus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	247	[325]
= <i>Agaricus tergiversans</i> Fr.:Fr. 1821		
<i>terreus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Schaeff.:Fr. 1774]	34	[57]
<i>tersus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr.:Fr. 1828]	168	[224]
<i>tessellatus</i> [‘tessulatus’], <i>Agaricus</i> (<i>Pleurotus</i>) [Bull.:Fr. 1791]	130	[168 ‘tessulatus’]
<i>tessulatus</i> [sic], <i>Agaricus</i> – See <i>tessellatus</i> , <i>Agaricus</i>		
<i>testaceoanescens</i> , † <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Weinm.) Fr. 1838, comb. nov.]	292	[374]
= <i>Agaricus testaceoanescens</i> Weinm. 1836		

Taxon	Page	[Hym. Eur. page]
<i>testaceus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr. 1838, nom. nov.]	178	[238]
nom. illegit., non <i>Agaricus testaceus</i> Scop. 1772, nec Huds. 1778, nec With. 1792, nec Pers. 1801, nec Alb. & Schwein. 1805, nec Sw. 1808 = <i>Agaricus subtestaceus</i> Batsch 1789		
<i>testaceus</i> , <i>Gomphidius viscidus</i> var. [Fr. 1838, var. nov.]	319	[400]
= <i>Agaricus rutilus</i> sensu Sowerby 1796–97, non Schaeff.:Fr. 1774		
<i>theiogalus</i> [' <i>thejogalus</i> '], <i>Lactarius</i> [(Bull.:Fr.) Gray 1821]	342	[432 ' <i>thejogalus</i> ']
= <i>Agaricus theiogalus</i> Bull.:Fr. 1792–93		
theiogalus [sic], <i>Lactarius</i> – See <i>theiogalus</i> , <i>Lactarius</i>		
<i>thunbergii</i> , <i>Lenzites</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	407	[-]
= <i>Daedalea thunbergii</i> Fr.:Fr. 1821		
<i>tigrinus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Schaeff. 1774]	45	[68]
unavailable name, non <i>Agaricus tigrinus</i> Bull.:Fr. 1781–82		
<i>tigrinus</i> , <i>Lentinus</i> [(Bull.:Fr.) Fr. 1825]	389	[481]
= <i>Agaricus tigrinus</i> Bull.:Fr. 1781–82		
tintinabulum [sic], <i>Agaricus</i> – See <i>tintinnabulum</i> , <i>Agaricus</i>		
<i>tintinnabulum</i> , <i>Agaricus</i> (<i>Mycena</i>)		
[(Paulet) Fr. 1838, comb. nov., ' <i>tintinabulum</i> ')	107	[140 ' <i>tintinabulum</i> ']
= <i>Hyphophyllum tintinnabulum</i> Paulet ?1793		
<i>tithymalinus</i> , <i>Lactarius</i> [(Scop.:Fr.) Fr. 1838, comb. nov.]	346	[436]
= <i>Agaricus tithymalinus</i> Scop.:Fr. 1772		
<i>titubans</i> , <i>Bolbitius</i> [(Bull.:Fr.) Fr. 1838, comb. nov.]	254	[334]
= <i>Agaricus titubans</i> Bull.:Fr. 1789		
<i>tofaceus</i> , <i>Cortinarius</i> (<i>Inoloma</i>) [Fr. 1838, sp. nov.]	281	[363 ' <i>tophaceus</i> ']
<i>togularis</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Bull. ex Pers.:Fr. 1801]	161	[216]
<i>tomentellus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr. 1838, nom. nov.]	176	[234]
nom. illegit., non <i>Agaricus tomentellus</i> Schumach. 1803 [= <i>Agaricus peronatus</i> β <i>tomentellus</i> (Schumach.:Fr.) Fr. 1821] = <i>Agaricus tomentosus</i> Jungh.:Fr. 1830, non Bull. 1783		
<i>tomentosus</i> , <i>Coprinus</i> [(Bull.) Fr. 1838, comb. nov.]	246	[325]
= <i>Agaricus tomentosus</i> Bull. 1783, non Jungh.:Fr. 1830 = <i>Agaricus Coprinus cinereus</i> γ <i>tomentosus</i> (Bull.:Fr.) Pers. 1801		
<i>tomentosus</i> , <i>Xerotus</i> [Klotzsch 1833]	401	[-]
<i>terminosus</i> , <i>Lactarius</i> [(Schaeff.:Fr.) Gray 1821]	334	[422]
= <i>Agaricus terminosus</i> Schaeff.:Fr. 1774		
<i>tornatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr.:Fr. 1821]	62	[87]
<i>torosus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr. 1838, sp. nov.]	160	[(215)]
= <i>Agaricus aureus</i> sensu Hornem. 1823, non Matt.:Fr. 1779		
<i>torpens</i> , <i>Agaricus</i> (<i>Psathyra</i>) [Fr.:Fr. 1821]	231	[305]
<i>tortilis</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Bolton 1788]	80[bis]	[109]
<i>tortuosus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	305	[389]
= <i>Agaricus tortuosus</i> Fr.:Fr. 1821		
<i>torulosus</i> , <i>Panus</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	397	[489]
= <i>Agaricus torulosus</i> Pers.:Fr. 1801		

Taxon	Page	[Hym. Eur. page]
<i>torvus, Cortinarius (Telamonia)</i>		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	293	[376]
= <i>Agaricus torvus</i> Fr.:Fr. 1818		
<i>trabea</i> [sic], <i>Lenzites</i> – See <i>trabeus, Lenzites</i>		
<i>trabeus, Lenzites</i> [(Pers.:Fr.) Fr. 1838, comb. nov., ‘trabea’] . . .	406	[494 ‘trabea’]
= <i>Agaricus trabeus</i> Pers.:Fr. 1801		
= <i>Daedalea trabea</i> (Pers.:Fr.) Fr. 1821		
<i>trachelinus, Agaricus (Mycena)</i> [Fr.:Fr. 1818]	118	[152]
<i>traganus, Cortinarius (Inoloma)</i>		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	281	[362]
= <i>Agaricus traganus</i> Fr.:Fr. 1818		
<i>translucens</i> , ? <i>Agaricus (Crepidotus)</i> [DC.:Fr. 1815]	211	[213]
<i>tremulus, Agaricus (Pleurotus)</i> [Schaeff.:Fr. 1774]	135	[177]
<i>trepidus, Agaricus (Psathyrella)</i> [Fr. 1838, sp. nov.]	238	[314]
<i>Tricholoma, Agaricus trib.</i> [Fr.:Fr. 1821]	25, 596	[2, 47]
<i>tricholoma, Agaricus (Flammula)</i> [Alb. & Schwein.:Fr. 1805] . .	184	[236]
<i>tricolor, Agaricus (Omphalia)</i> [Alb. & Schwein.:Fr. 1805]	124	[159]
<i>tricolor, Lenzites</i> [(Bull.) Fr. 1838, comb. nov.]	406	[494]
= <i>Agaricus tricolor</i> Bull. 1792		
<i>triformis, Cortinarius (Telamonia)</i> [Fr. 1838, sp. nov.]	299	[382]
= <i>Agaricus caesareus</i> sensu Schaeff. 1771, t.247, non Scop.:Fr. 1772		
<i>trigonophyllus, Agaricus (Naucoria) furfuraceus</i> var.		
[(Lasch) Fr. 1838, comb. nov.]	200	[273]
= <i>Agaricus trigonophyllus</i> Lasch:Fr. 1828		
<i>trinii, Agaricus (Hebeloma)</i> [Weinm. 1836]	175	[233]
<i>tristis, Agaricus (Tricholoma)</i> [Scop. 1772]	34	[58]
<i>triumphans, Cortinarius (Phlegmacium)</i> [Fr. 1838, sp. nov.] .	256	[336]
<i>trivialis, Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	337	[426]
= <i>Agaricus trivialis</i> Fr.:Fr. 1815		
<i>trochilus, Agaricus (Collybia)</i> [Lasch ex Fr. 1838, sp. nov.] . . .	87	[116]
<i>Trogia</i> [Fr. 1836]	402, 602	[10, 491]
<i>trogii, Agaricus (Clitocybe)</i> [Fr. 1838, sp. nov.]	59	[85]
= <i>Agaricus suaveolens</i> sensu Trog 1832, non Schumach.:Fr. 1803		
<i>trullaeformis</i> [sic], <i>Agaricus</i> – See <i>trulliformis, Agaricus</i>		
<i>trulliformis</i> [‘trullaeformis’], <i>Agaricus (Clitocybe)</i> [Fr.:Fr. 1821] .	68	[94 ‘trullaeformis’]
<i>truncatus, Agaricus (Hebeloma)</i> [Schaeff. 1774]	181	[242]
<i>truncorum, Coprinus</i> [(Scop.) Fr. 1838, comb. nov.]	248	[326]
= <i>Agaricus truncorum</i> Scop. 1772		
<i>tuba, Agaricus (Clitocybe)</i> [Fr. 1838, nom. nov.]	72	[99]
= <i>Hypophyllum tubaeforme</i> Paulet ?1793		
<i>tubaeformis, Cantharellus</i> [(Bull.:Fr.) Fr. 1821]	366	[457]
= <i>Helvella tubaeformis</i> Bull.:Fr. 1790		
<i>tuber-regium, Lentinus</i> [(Rumph. ex Fr.:Fr.) Fr. 1832]	392	[–]
= <i>Agaricus tuber-regium</i> Rumph. ex Fr.:Fr. 1821		
<i>tuberculosis, Agaricus (Pholiota)</i> [Schaeff.:Fr. 1774]	167	[223]

Taxon	Page	[Hym. Eur. page]
<i>tuberosus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Bull.:Fr. 1785–86]	90	[119]
<i>tumidus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Pers.:Fr. 1801]	38	[61]
<i>turbidus</i> , <i>Agaricus</i> (<i>Entoloma</i>) [Fr.:Fr. 1821]	147	[195]
<i>turbinatus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Bull.:Fr.) Fr. 1838, comb. nov.]	266	[346]
= <i>Agaricus turbinatus</i> Bull.:Fr. 1782–83		
<i>turgidus</i> , <i>Cortinarius</i> (<i>Inoloma</i>) [Fr. 1838, sp. nov.]	278	[360]
<i>turmalis</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>) [Fr. 1838, nom. nov.]	257	[336]
= <i>Agaricus multiformis</i> γ <i>obscurior</i> Fr. 1818		
<i>turpis</i> , <i>Lactarius</i> [(Weinm.) Fr. 1838, comb. nov.]	335	[423]
= <i>Agaricus turpis</i> Weinm. 1826		
<i>turritus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	51	[74]
<i>turundus</i> , <i>Hygrophorus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	330	[418]
= <i>Agaricus turundus</i> Fr.:Fr. 1818		
<i>tylicolor</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr.:Fr. 1818]	98	[129]
<i>tyrianthinus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1818]	58	[82]
U		
<i>udus</i> , <i>Agaricus</i> (<i>Psilocybe</i>) [Pers.:Fr. 1801]	228	[298]
<i>ulmarius</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Bull.:Fr. 1791]	130	[167]
<i>umbellatus</i> , <i>Lentinus</i> [Fr. 1836]	393	[484]
<i>umbelliferus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [L.:Fr. 1753]	124	[160]
<i>umbilicatus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Schaeff. 1774]	121	[155]
nom. illegit., non <i>Agaricus umbilicatus</i> Scop. 1772		
<i>umbonatus</i> , <i>Cantharellus</i> [(J.F.Gmel.:Fr.) Pers. 1794]	365	[457]
= <i>Merulius umbonatus</i> J.F.Gmel.:Fr. 1792		
<i>umbraculatus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr. 1838, nom. nov.]	126	[-]
= <i>Agaricus umbraculum</i> Klotzsch 1833, nom. illegit., non Scop. 1772, nec Batsch 1783		
<i>umbratilis</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr.:Fr. 1821]	127	[164]
<i>umbrina</i> [sic], <i>Lenzites</i> – See <i>umbrinus</i> , <i>Lenzites</i>		
<i>umbrinellus</i> , <i>Agaricus</i> (<i>Pluteus</i>) [Sommerf.:Fr. 1826]	142	[188]
<i>umbrinus</i> , <i>Lactarius</i> [Fr. 1838, nom. nov.]	339	[429]
= <i>Agaricus Lactifluus umbrinus</i> Pers. 1801,		
nom. illegit., non <i>Agaricus umbrinus</i> J.F.Gmel. 1792		
<i>umbrinus</i> , <i>Lenzites</i> [Fr. 1838, sp. nov., ‘ <i>umbrina</i> ’]	405	[-]
<i>umbrosus</i> , <i>Agaricus</i> (<i>Pluteus</i>) [Pers.:Fr. 1798]	140	[186]
<i>undatus</i> , <i>Agaricus</i> (<i>Clitopilus</i>) [Fr. 1838, sp. nov.]	149	[199]
= <i>Agaricus hirneolus</i> Secr. 1833, nom. inval. et illegit., non Fr.:Fr. 1818		
<i>undulatus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) <i>hirneolus</i> var.		
[(Bull.:Fr.) Fr. 1821]	58	[82]
= <i>Agaricus undulatus</i> Bull. 1792, non Jungh.:Fr. 1830		
<i>undulosus</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr. 1838, nom. nov.]	199	[261]
= <i>Agaricus undulatus</i> Jungh.:Fr. 1830		
<i>unguentatus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr. 1838, sp. nov.]	27	[57]
<i>unguicularis</i> , <i>Agaricus</i> (<i>Pleurotus</i>) [Fr.:Fr. 1828]	137	[180]

Taxon	Page	[Hym. Eur. page]
<i>unguinus</i> , <i>Hygrophorus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.] . . .	332	[421]
= <i>Agaricus unguinosus</i> Fr.:Fr. 1821		
<i>unicolor</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Vahl:Fr. 1792]	170	[225]
<i>uraceus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>) [Fr. 1838, sp. nov.]	309	[393]
<i>uranius</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1818]	112	[145]
<i>urbicus</i> , <i>Cortinarius</i> (<i>Telamonia</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	293	[375]
= <i>Agaricus urbicus</i> Fr.:Fr. 1821		
<i>urbus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1821]	53	[76]
<i>urens</i> , <i>Marasmius</i> [(Bull.:Fr.) Fr. 1836]	373	[465]
= <i>Agaricus urens</i> Bull.:Fr. 1791		
<i>ursinus</i> , <i>Lentinus</i> [(Fr.:Fr.) Fr. 1825]	395	[486]
= <i>Agaricus ursinus</i> Fr.:Fr. 1821		
<i>ustalis</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1818]	29	[51]
<i>utilis</i> , [†] <i>Lactarius</i> [(Weinm.) Fr. 1838, comb. nov.]	337	[425]
= <i>Agaricus utilis</i> Weinm. 1836		
<i>uvidus</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	338	[426]
= <i>Agaricus uvidus</i> Fr.:Fr. 1818		
V		
<i>vaccinus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Schaeff.:Fr. 1774]	33	[56 'Pers.']
<i>vagans</i> , <i>Agaricus</i> (<i>Armillaria</i>) [Fr.:Fr. 1821]	24	[319]
<i>vaginatus</i> , <i>Agaricus</i> (<i>Amanita</i>) [Bull.:Fr. 1782–83]	11	[27]
<i>vahlilii</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Schumach.:Fr. 1803]	161	[214 sub <i>Agaricus aureus</i>]
<i>vaillantii</i> , <i>Marasmius</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	380	[472]
= <i>Agaricus ericetorum</i> β <i>vaillantii</i> Pers. 1801		
= <i>Agaricus vaillantii</i> (Pers.:Fr.) Fr. 1821		
<i>valgus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>) [Fr. 1838, sp. nov.]	290	[373]
= <i>Agaricus sublanatus</i> b. Fr. 1821		
<i>validus</i> , <i>Agaricus</i> (<i>Amanita</i>) [Fr. 1838, sp. nov.]	7	[23]
= <i>Amanita umbrina</i> sensu Alb. & Schwein. 1805, non Pers. 1797		
<i>vapidus</i> , <i>Agaricus</i> (<i>Amanita</i>) <i>lenticularis</i> var.		
[Fr. 1838, var. nov.]	10	[26]
= <i>Amanita excoriata</i> Secr. 1833, nom. inval.		
<i>vaporarius</i> , <i>Agaricus</i> (<i>Psalliota</i>) <i>campestris</i> var. [Pers. 1801]	213	[280 sub <i>Agaricus campestris</i>]
<i>variabilis</i> , <i>Agaricus</i> (<i>Crepidotus</i>) [Pers.:Fr. 1800]	211	[213]
<i>varicosus</i> , <i>Marasmius</i> [Fr. 1838, sp. nov.]	376	[469]
<i>varicus</i> , <i>Coprinus</i> [Fr. 1838, sp. nov.]	244	[323]
<i>variecolor</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Pers.:Fr.) Fr. 1838, comb. nov.]	259	[338 'varicolor']
= <i>Agaricus variecolor</i> Pers.:Fr. 1801		
<i>variegata</i> [sic], <i>Lenzites</i> – See <i>variegatus</i> , <i>Lenzites</i>		
<i>variegatus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Scop. 1772]	31	[53]
unavailable name, non <i>Agaricus variegatus</i> Pers.:Fr. 1801		

Taxon	Page	[Hym. Eur. page]
<i>variegatus</i> , <i>Lenzites</i> [(Fr.:Fr.) Fr. 1838, 'variegata']	406	[493 'variegata']
= <i>Daedalea variegata</i> Fr.:Fr. 1818		
<i>varius</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Schaeff.:Fr.) Fr. 1838, comb. nov.]	258	[338]
= <i>Agaricus varius</i> Schaeff.:Fr. 1774		
<i>vaticosus</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr.:Fr. 1818]	177	[236]
<i>vebsicolor</i> [sic], <i>Agaricus</i> – See <i>versicolor</i> , <i>Agaricus</i>		
<i>velaris</i> , <i>Coprinus</i> [Fr. 1838, sp. nov.]	253	[332]
<i>vellereus</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	340	[430]
= <i>Agaricus vellereus</i> Fr.:Fr. 1821		
<i>velutinus</i> , <i>Agaricus</i> (<i>Hypholoma</i>) [Pers. 1801]	223	[293]
unavailable name, non <i>Agaricus velutinus</i> Fr.:Fr. 1830		
= <i>Agaricus lacrymabundus</i> β <i>A. velutinus</i> (Pers.:Fr.) Fr. 1821		
<i>velutinus</i> , <i>Lentinus</i> (<i>Scleroma</i>) [Fr.:Fr. 1830]	392	[-]
<i>velutinus</i> , <i>Panus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	398	[-]
= <i>Agaricus velutinus</i> Fr.:Fr. 1830		
<i>velutipes</i> , <i>Agaricus</i> (<i>Collybia</i>) [Curtis:Fr. 1782]	86	[115]
<i>venetus</i> , <i>Cortinarius</i> (<i>Dermocybe</i>) [(Fr.) Fr. 1838, comb. nov.]	291	[374]
= <i>Agaricus raphanoides</i> β <i>venetus</i> Fr.:Fr. 1821		
<i>ventosus</i> , <i>Agaricus</i> (<i>Omphalia</i>) [Fr. 1818]	120	[155]
<i>ventricosus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Bull.:Fr. 1789]	91	[120]
<i>verecundus</i> , <i>Agaricus</i> (<i>Nolanea</i>) [Fr. 1836]	158	[210]
<i>vermicularis</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1838, sp. nov.]	72	[98]
= <i>Agaricus sinopicus</i> Secr. 1833, nom. inval. et illegit., non Fr.:Fr. 1818		
<i>vernicosus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [(Fr.) Fr. 1838, comb. nov.] . .	60	[84]
= <i>Agaricus cerinus</i> β <i>vernicosus</i> Fr.:Fr. 1821		
<i>vernus</i> , <i>Agaricus</i> (<i>Amanita</i>) <i>virosus</i> var.		
[(Bull.) Fr. 1838, comb. nov.]	4	[18 as <i>Agaricus phalloides</i> * <i>vernus</i>]
= <i>Agaricus bulbosus</i> var. <i>vernus</i> Bull. 1782–83		
= <i>Amanita verna</i> (Bull.:Fr.) Lam. 1783		
= <i>Agaricus vernus</i> (Bull.:Fr.) DC. 1805		
<i>verpoides</i> , <i>Nyctalis</i> [Fr. 1838, sp. nov.]	371	[463]
<i>verruculosus</i> , <i>Agaricus</i> (<i>Pholiota</i>) <i>squarrosus</i> var.		
[(Lasch) Fr. 1838, comb. nov.]	166	[221]
= <i>Agaricus verruculosus</i> Lasch 1828		
<i>versicolor</i> ['vebsicolor'], <i>Agaricus</i> (<i>Psalliota</i>) [With.:Fr. 1796] . .	218	[284]
<i>versipellis</i> , <i>Agaricus</i> (<i>Hebeloma</i>) [Fr. 1838, nom. nov.]	179	[239]
= <i>Agaricus lubricus</i> St.-Amans 1821, nom. illegit., non Scop. 1772, nec Pers.:Fr. 1801		
<i>vervacti</i> , <i>Agaricus</i> (<i>Naucoria</i>) [Fr.:Fr. 1821]	197	[260]
<i>vesca</i> , <i>Russula</i> [Fr. 1836]	352	[446]
<i>vespertinus</i> , <i>Cortinarius</i> (<i>Phlegmacium</i>)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	272	[353]
= <i>Agaricus vespertinus</i> Fr.:Fr. 1821		
<i>veternosa</i> , <i>Russula</i> [Fr. 1838, nom. nov.]	354	[450]
= <i>Hypophyllum integrum</i> (<i>russula</i>) Paulet ?1793		

Taxon	Page	[Hym. Eur. page]
<i>vibecinus</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Fr. 1818]	75	[102]
<i>vibratilis</i> , <i>Cortinarius</i> (<i>Myxaci</i> um)		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	277	[358]
≡ <i>Agaricus vibratilis</i> Fr.:Fr. 1821		
<i>vietus</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	344	[432]
≡ <i>Agaricus vietus</i> Fr.:Fr. 1821		
<i>vilis</i> , <i>Agaricus</i> (<i>Clitopilus</i>) [Fr. 1838, nom. nov.]	150	[200]
≡ <i>Agaricus parilis</i> Lasch 1829, nom. illegit., non Fr.:Fr. 1818		
<i>villaticus</i> , <i>Agaricus</i> (<i>Psalliota</i>) <i>campestris</i> var.		
[(Brond.) Fr. 1838, comb. nov.]	213	[280 sub <i>Agaricus</i> <i>campestris</i>]
≡ <i>Agaricus villaticus</i> Brond. 1829		
<i>villosus</i> , <i>Agaricus</i> (<i>Pholiota</i>) [Fr.:Fr. 1828]	166	[222]
<i>villosus</i> , <i>Lentinus</i> [Klotzsch 1833]	388	[-]
<i>vinaceus</i> , <i>Agaricus</i> (<i>Nolanea</i>) [Scop. 1772]	157	[208]
<i>vinosus</i> , <i>Agaricus</i> (<i>Flammula</i>) [Bull.:Fr. 1781–82]	183	[244]
<i>violaceocinereus</i> , <i>Cortinarius</i> (<i>Inoloma</i>)		
[(Pers.:Fr.) Fr. 1838, comb. nov.]	279	[361‘ <i>cinereoviolaceus</i> ’]
≡ <i>Agaricus violaceocinereus</i> Pers.:Fr. 1800		
<i>violaceofulvens</i> [‘ <i>violaceofulvus</i> ’], <i>Agaricus</i> (<i>Crepidotus</i>)		
[Batsch:Fr. 1783]	212	[490 as <i>Panus</i> ‘ <i>violaceofulvus</i> ’]
<i>violaceofulvus</i> [sic], <i>Agaricus</i> – See <i>violaceofulvens</i> , <i>Agaricus</i>		
<i>violaceus</i> , <i>Cortinarius</i> (<i>Inoloma</i>) [(L.:Fr.) Gray 1821]	279	[360]
≡ <i>Agaricus violaceus</i> L.:Fr. 1753		
<i>violascens</i> , <i>Lactarius</i> [(J.Otto:Fr.) Fr. 1838, comb. nov.]	342	[429]
≡ <i>Agaricus violascens</i> J.Otto:Fr. 1816		
<i>viperinus</i> , <i>Agaricus</i> (<i>Volvaria</i>) [Fr. 1838, nom. nov.]	139	[184]
≡ <i>Agaricus conicus</i> Picco 1781, nom. illegit., non Scop.:Fr. 1772		
<i>virescens</i> , <i>Russula</i> [(Schaeff.) Fr. 1836]	355	[443]
≡ <i>Agaricus virescens</i> Schaeff. 1774		
<i>virgatus</i> , <i>Agaricus</i> (<i>Tricholoma</i>) [Fr.:Fr. 1818]	39	[62]
<i>virgineus</i> , <i>Hygrophorus</i> [(Wulfen:Fr.) Fr. 1838, comb. nov.]	327	[413]
≡ <i>Agaricus virgineus</i> Wulfen:Fr. 1781		
<i>viridis</i> , <i>Agaricus</i> (<i>Clitocybe</i>) [Huds.:Fr. 1778]	59	[85]
<i>viridis</i> , <i>Lactarius</i> [(Paulet) Fr. 1838, comb. nov.]	339	[429]
≡ <i>Hygrophylum viride</i> Paulet ?1793		
<i>virosus</i> , <i>Agaricus</i> (<i>Amanita</i>) [(Paulet) Fr. 1838, comb. nov.]	3	[18]
nom. illegit., non <i>Agaricus virosus</i> Sowerby 1809–14		
≡ <i>Hypophyllum virosum</i> Paulet ?1793		
<i>virosus</i> , [†] <i>Agaricus</i> (<i>Psalliota</i>) [Sowerby 1809–14]	221	[-]
<i>viscidus</i> , <i>Gomphidius</i> [(L.) Fr. 1838, comb. nov.]	319	[400]
≡ <i>Agaricus viscidus</i> L. 1753		
<i>vitellina</i> , <i>Russula nauseosa</i> var.		
[(Pers.) Fr. 1838, comb. nov.]	363	[454 as <i>Russula</i> <i>vitellina</i>]
≡ <i>Agaricus Russula vitellinus</i> Pers. 1801, p. 442, non <i>Agaricus Coprinus vitellinus</i> Pers.:Fr. 1801, p. 402		

Taxon	Page	[Hym. Eur. page]
<i>vitellinus</i> , <i>Bolbitius</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	254	[333]
= <i>Agaricus Coprinus vitellinus</i> Pers.:Fr. 1801, p. 402		
<i>vitalis</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr. 1838, sp. nov.]	113	[145]
= <i>Agaricus tenuis</i> sensu Sowerby 1800–03, non Bolton 1788		
<i>vitreus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1821]	111	[143]
<i>vittadini</i> [sic], <i>Agaricus</i> – See <i>vittadinii</i> , <i>Agaricus</i>		
<i>vittadinii</i> ['vittadini'], <i>Agaricus</i> (<i>Lepiota</i>) [Moretti 1826]	16	[33]
= <i>Amanita vittadinii</i> (Moretti) Vittad. 1826		
<i>vittaeformis</i> [sic], <i>Agaricus</i> – See <i>vittiformis</i> , <i>Agaricus</i>		
<i>vittiformis</i> , <i>Agaricus</i> (<i>Galera</i>)		
[Fr. 1838, sp. nov., 'vittaeformis']	207	[269 'vittaeformis']
<i>volemus</i> , <i>Lactarius</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	344	[435]
= <i>Agaricus volemus</i> Fr.:Fr. 1821		
<i>volvaceus</i> , <i>Agaricus</i> (<i>Volvaria</i>) [Bull.:Fr. 1786]	138	[182]
<i>Volvaria</i> , <i>Agaricus</i> trib. [Fr.:Fr. 1821]	138, 598	[4, 182]
<i>vopiscus</i> , <i>Nyctalis</i> [Fr. 1838, sp. nov.]	372	[464]
<i>vulgaris</i> , <i>Agaricus</i> (<i>Mycena</i>) [Pers.:Fr. 1794]	116	[150]
<i>vulpinus</i> , <i>Lentinus</i> [(Sowerby:Fr.) Fr. 1836]	395	[486]
= <i>Agaricus vulpinus</i> Sowerby:Fr. 1800–03		

W

<i>weinmanni</i> [sic], <i>Agaricus</i> – See <i>weinmannii</i> , <i>Agaricus</i>		
<i>weinmannii</i> , <i>Agaricus</i> (<i>Flammula</i>)		
[Fr. 1838, sp. nov., 'weinmanni']	183	[319 'weinmanni']
= <i>Agaricus vinosus</i> sensu Weinm. 1836, non Bull.:Fr. 1781–82		

X

<i>xanthopus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Fr.:Fr. 1815]	91	[120]
<i>xerampelina</i> , <i>Russula</i> [(Schaeff.) Fr. 1838, comb. nov.]	356	[445]
= <i>Agaricus xerampelinus</i> Schaeff. 1774		
<i>Xerotus</i> [Fr.:Fr. 1825]	400, 602	[10, 491]
<i>xylophilus</i> , <i>Agaricus</i> (<i>Collybia</i>) [Weinm. 1835]	86	[114]
nom. illegit., non <i>Agaricus xylophilus</i> Bull. 1792,		
nec Sowerby 1798–99, nec (Pers.) Pers. 1801		

Z

<i>zephirus</i> , <i>Agaricus</i> (<i>Mycena</i>) [Fr.:Fr. 1818]	102	[133]
<i>zinziberatus</i> , <i>Cortinarius</i> (<i>Hydrocybe</i>)		
[(Scop.) Fr. 1838, comb. nov.]	309	[392]
= <i>Agaricus zinziberatus</i> Scop. 1772		
<i>zonarius</i> , <i>Lactarius</i> [(Bull.) Fr. 1838, comb. nov.]	336	[425]
= <i>Agaricus lactifluus</i> var. <i>zonarius</i> Bull. 1782–83		
= <i>Agaricus zonarius</i> (Bull.) Bull. 1792–93		

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An index to Fries's *Epicrisis Systematis Mycologici*, 1838 2: Polyporei, Hydnei, Auricularini, Clavariei, Tremellinae

S.R. PENNYCOOK

PennycookS@LandcareResearch.co.nz

Manaaki Whenua Landcare Research

Private Bag 92 170, Auckland, New Zealand

Abstract—All the generic, specific, and varietal taxa (except those under 'Ord. I. Agaricini') in Fries's *Epicrisis Systematis Mycologici* are indexed and annotated with basionyms and other nomenclatural synonyms published before 1838. All names are provided with accurate authorities and publication dates. The index covers 44 genera: *Agyrium*, *Auricularia*, *Boletus*, *Calocera*, *Clavaria*, *Cora*, *Corticium*, *Craterellus*, *Crinula*, *Cyclomyces*, *Cyphella*, *Dacrymyces*, *Daedalea*, *Exidia*, *Favolus*, *Fistulina*, *Geoglossum*, *Grandinia*, *Guepinia*, *Hericium*, *Hexagonia*, *Hydnum*, *Hymenula*, *Hypochnus*, *Irpex*, *Kneiffia*, *Laschia*, *Merulius*, *Midotis*, *Mitrla*, *Naematelia*, *Odontia*, *Phlebia*, *Pistillaria*, *Polyporus*, *Porothelium*, *Radulum*, *Sistotrema*, *Sparassis*, *Stereum*, *Thelephora*, *Trametes*, *Tremella*, and *Typhula*.

Key words—nomenclature, hymenomycetes, *Aphyllophorales*

Introduction

Epicrisis Systematis Mycologici (Fries 1838) is a major publication in which Elias Fries presented his first comprehensive revision and overview of hymenomycetous fungi subsequent to the early volumes of his sanctioning works (Fries 1821, 1822, 1832). However, access to the contents of *Epicrisis* and its numerous nomenclatural novelties has been hampered by the lack of an index (Pennycook 2007).

This publication completes an annotated index to all the generic, specific, and varietal taxa accepted in *Epicrisis*. The first part of the index (Pennycook 2007) dealt with 'Ord. I. Agaricini' (Fries 1838, pp. 2–408). This second part deals with 'Ord. II. Polyporei' (Fries 1838, pp. 408–504), including 10 genera: *Boletus*, *Cyclomyces*, *Daedalea*, *Favolus*, *Hexagonia* ('*Hexagona*'), *Laschia*, *Merulius*, *Polyporus*, *Porothelium* ('*Porothelium*'), *Trametes*; 'Ord. III. Hydnei' (Fries 1838, pp. 504–530) including 10 genera: *Fistulina*, *Grandinia*, *Hericium*, *Hydnum*, *Irpex*, *Kneiffia*, *Odontia*, *Phlebia*, *Radulum*, *Sistotrema*; 'Ord. IV. Auricularini'

(Fries 1838, pp. 530–570) including 10 genera: *Auricularia*, *Cora*, *Corticium*, *Craterellus*, *Cyphella*, *Guepinia*, *Hypochnus*, *Midotis*, *Stereum*, *Thelephora*; ‘Ord. V. Clavariei’ (Fries 1838, pp. 570–587) including 8 genera: *Calocera*, *Clavaria*, *Crinula*, *Geoglossum*, *Mitrula*, *Pistillaria*, *Sparassis*, *Typhula*; and ‘Ord. VI. Tremellinae’ (Fries 1838, pp. 587–594) including 6 genera: *Agyrium*, *Dacrymyces*, *Exidia*, *Hymenula*, *Naematelia*, *Tremella*.

For details of the organisation of the index, see Pennycook (2007).

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Epicrisis Systematis Mycologici Index.

2: Polyporei, Hydnei, Auricularini, Clavariei, Tremellinae

Taxon	Page	[Hym. Eur. page]
A		
<i>abietina</i> , <i>Clavaria</i> [Pers.:Fr. 1794]	574	[671]
<i>abietinum</i> , <i>Stereum</i> [(Pers.:Fr.) Fr. 1818]	553	[643]
= <i>Thelephora abietina</i> Pers.:Fr. 1801		
<i>abietinus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1821]	479	[569]
= <i>Boletus abietinus</i> Pers.:Fr. 1792		
<i>acanthoides</i> , <i>Polyporus</i> [(Bull.) Fr. 1838, comb. nov.]	448	[540]
= <i>Boletus acanthoides</i> Bull. 1791		
<i>acerinum</i> , <i>Stereum</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	554 ['553']	[645 as " <i>Th. acerina</i> "]
= <i>Corticium acerinum</i> Pers.:Fr. 1796		
<i>acuta</i> , <i>Clavaria</i> [Sowerby:Fr. 1800–03]	580	[679]
<i>adustum</i> , <i>Hydnum</i> [Schwein.:Fr. 1822]	510	[–]
<i>adustus</i> , <i>Polyporus</i> [(Willd.:Fr.) Fr. 1821]	456	[549]
= <i>Boletus adustus</i> Willd.:Fr. 1787		
aeneus [sic], <i>Boletus</i> – See <i>aereus</i> , <i>Boletus</i>		
<i>aereus</i> ['aeneus'], <i>Boletus</i> [Bull.:Fr. 1789]	420	[508]
<i>aesculi</i> , <i>Polyporus</i> [Fr.:Fr. 1828]	455	[–]
= <i>Boletus aesculi-flavae</i> Schwein. 1822		
<i>aestivalis</i> , <i>Boletus</i> [(Paulet) Fr. 1838, comb. nov.]	422	[510]
= <i>Tubiporus aestivalis</i> Paulet ?1793		
<i>affinis</i> , <i>Polyporus</i> [Blume & T.Nees:Fr. 1826]	445	[–]
<i>afzelii</i> , <i>Polyporus</i> [Fr.:Fr. 1828]	461	[–]
<i>agardhii</i> , <i>Grandinia</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	528	[626]
= <i>Hydnum agardhii</i> Fr.:Fr. 1814		
<i>Agryrium</i> [Fr.:Fr. 1822]	593, 608	[–]
<i>albida</i> , <i>Tremella</i> [Huds.:Fr. 1778]	589	[691]
<i>albidus</i> , <i>Polyporus</i> [(Schaeff.) Trog ex Fr. 1838, comb. nov.]	475	[567]
= <i>Boletus albidus</i> Schaeff. 1774		
<i>alboater</i> , <i>Boletus</i> [Schwein.:Fr. 1822]	424	[–]
<i>albobadium</i> , <i>Stereum</i> [(Schwein.:Fr.) Fr. 1838, comb. nov.]	551	[–]
= <i>Thelephora albobadia</i> Schwein.:Fr. 1822		
<i>albocinctus</i> , <i>Hypochnus</i> [Mont. ex Fr. 1838, sp. nov.]	569	[–]
<i>albus</i> , <i>Polyporus</i> [(Huds.) Fr. 1838, comb. nov.]	456	[549]
= <i>Boletus albus</i> Huds. 1762		
<i>alliacea</i> , <i>Odontia</i> [(Weinm.) Fr. 1838, comb. nov.]	529	[628]
= <i>Hydnum alliaceum</i> Weinm. 1832		
<i>alligatus</i> , <i>Polyporus</i> [Fr.:Fr. 1828]	450	[543]
<i>alneum</i> , <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	554 ['553']	[644]
= <i>Thelephora alnea</i> Fr.:Fr. 1821		
<i>alutaceum</i> , <i>Hydnum</i> [Fr.:Fr. 1821]	516	[614]
<i>alutaceus</i> , <i>Polyporus</i> [Fr.:Fr. 1821]	453	[545]
<i>alutarius</i> , <i>Boletus</i> [Fr. 1815]	425	[516]

Taxon	Page	[Hym. Eur. page]
<i>alveolarius</i> , <i>Polyporus</i> [(Bosc:Fr.) Fr. 1821]	431	[-]
= <i>Boletus alveolarius</i> Bosc:Fr. 1811		
= <i>Favolus alveolarius</i> (Bosc:Fr.) Fr. 1825		
amarus , <i>Boletus pachypus</i> var. [(Pers.) Fr. 1838, comb. nov.] .	417	[-]
= <i>Boletus amarus</i> Pers. 1801		
<i>amboinensis</i> , <i>Polyporus</i> [(Lam.:Fr.) Fr. 1821]	442	[-]
= <i>Agaricus amboinensis</i> Lam.:Fr. 1783		
<i>amethystea</i> ['amethystina'], <i>Clavaria</i> [Bull.:Fr. 1791]	571	[667 'amethystina']
<i>amethystina</i> [sic], <i>Clavaria</i> – See <i>amethystea</i> , <i>Clavaria</i>		
amorphum , <i>Corticium</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	559	[648]
= <i>Peziza amorpha</i> Pers.:Fr. 1801		
= <i>Thelephora amorpha</i> (Pers.:Fr.) Fr. 1828		
<i>amorphus</i> , <i>Polyporus</i> [Fr.:Fr. 1818]	457	[550]
amphibolium , <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.] .	554	[553']
= <i>Thelephora amphibolia</i> Fr.:Fr. 1815		[645 as "Th. amphibola" (sic)]
<i>aneirinus</i> , <i>Polyporus</i> [Sommerf.:Fr. 1826]	487	[575]
<i>angustata</i> , <i>Daedalea</i> [(Sowerby:Fr.) Pers. 1801]	494	[587 as <i>Daedalea</i> <i>confragosa</i> * <i>angustata</i>]
= <i>Boletus angustatus</i> Sowerby:Fr. 1798–99		
<i>annosus</i> , <i>Polyporus</i> [Fr.:Fr. 1821]	471	[564]
<i>anomala</i> , <i>Clavaria</i> [Fr.:Fr. 1818]	576	[673]
anthocephala , <i>Thelephora</i> [(Bull.:Fr.) Fr. 1838, comb. nov.] .	535	[634]
= <i>Clavaria anthocephala</i> Bull.:Fr. 1790		
= <i>Thelephora palmata</i> β <i>T. anthocephala</i> (Bull.:Fr.) Fr. 1821		
<i>anthochroa</i> , <i>Thelephora</i> [Pers.:Fr. 1801]	544	[661 as <i>Corticium</i> <i>anthochroum</i>]
apiaria , <i>Hexagonia</i> [(Pers.) Fr. 1838, comb. nov.]	497	[-]
= <i>Polyporus apiarius</i> Pers. 1827		
<i>apiculata</i> , <i>Clavaria</i> [Fr.:Fr. 1818]	575	[673]
<i>appendiculatus</i> , <i>Boletus</i> [Schaeff. 1774]	416	[505]
<i>applanatus</i> , <i>Polyporus</i> [(Pers.) Wallr. 1833]	465	[557]
= <i>Boletus applanatus</i> Pers. 1800		
arcticus , <i>Polyporus</i> [Fr. 1838, sp. nov.]	479	[-]
<i>arcularius</i> , <i>Polyporus</i> [(Batsch:Fr.) Fr. 1821]	430	[526]
= <i>Boletus arcularius</i> Batsch:Fr. 1783		
<i>ardenia</i> , <i>Clavaria</i> [Sowerby:Fr. 1798–99]	579	[677 as <i>Clavaria</i> <i>fistulosa</i> * <i>ardenia</i>]
<i>arenarius</i> , <i>Polyporus</i> [Klotzsch 1833]	487	[-]
areolatum , <i>Stereum</i> [(Chaillet ex Fr.:Fr.) Fr. 1838, comb. nov.]	552	[642]
= <i>Thelephora areolata</i> Chaillet ex Fr.:Fr. 1828		
<i>argillacea</i> , <i>Clavaria</i> [Pers.:Fr. 1797]	577	[675]
<i>argutum</i> , <i>Hydnum</i> [Fr.:Fr. 1821]	519	[616]
<i>arida</i> , <i>Thelephora</i> [Fr.:Fr. 1828]	543	[659 as <i>Corticium</i> <i>aridum</i>]
<i>arundinis</i> , <i>Hymenula</i> [(Fr.:Fr.) Fr. 1828]	594	[701]
= <i>Hymenella arundinis</i> Fr.:Fr. 1822		
asprellus , <i>Boletus</i> [Fr. 1838, sp. nov.]	423	[514]

Taxon	Page	[Hym. Eur. page]
<i>aterrimum</i> , <i>Radulum</i> [(Fr.:Fr.) Fr. 1828]	526	[624]
= <i>Hydnum aterrimum</i> Fr.:Fr. 1821		
<i>atra</i> , <i>Thelephora</i> [Weinm. 1836]	538	[636]
<i>atratum</i> , <i>Stereum</i> [(Sw.:Fr.) Fr. 1838, comb. nov.]	547	[-]
= <i>Helvella atrata</i> Sw.:Fr. 1788		
= <i>Thelephora atrata</i> (Sw.:Fr.) Sw. 1806		
<i>atropurpureum</i> , <i>Geoglossum</i> [(Batsch:Fr.) Pers. 1800]	582	[-]
= <i>Clavaria atropurpurea</i> Batsch:Fr. 1783		
<i>atrovirens</i> , <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	562	[651]
= <i>Thelephora atrovirens</i> Fr.:Fr. 1828		
<i>aurantia</i> , <i>Tremella</i> [Schwein.:Fr. 1822]	588	[-]
<i>aurantiaca</i> , <i>Thelephora</i> [Pers. 1827]	536	[-]
<i>aurantiacum</i> , <i>Hydnum</i> [(Batsch:Fr.) Alb. & Schwein. 1805]	508	[603]
= <i>Hydnum suberosum</i> var. β <i>aurantiacum</i> Batsch:Fr. 1789		
<i>aurea</i> , <i>Clavaria</i> [Schaeff. 1774]	574	[670]
<i>aurea</i> , <i>Daedalea</i> [Fr.:Fr. 1821]	493	[587]
<i>aureum</i> , <i>Hydnum</i> [Fr.:Fr. 1828]	516	[613]
<i>aureus</i> , <i>Boletus elegans</i> var. [Fr. 1838, var. nov.]	409	[-]
= <i>Boletus aureus</i> sensu Muhl. 1813, non Schaeff. 1774		
<i>aureus</i> , <i>Hypochnus</i> [Fr.:Fr. 1818]	570	[661 as <i>Corticium aureum</i>]
<i>aureus</i> , <i>Merulius</i> [Fr.:Fr. 1828]	501	[592]
<i>auricula-canis</i> , <i>Exidia</i> [(G.Mey.:Fr.) Fr. 1822]	590	[-]
= <i>Tremella auricula-canis</i> G.Mey.:Fr. 1818		
<i>auricula-judae</i> , <i>Exidia</i> [(Bull.:Fr.) Fr. 1822]	590	[695 as <i>Hirneola auricula-judae</i>]
= <i>Tremella auricula-judae</i> Bull.:Fr. 1789		
<i>Auricularia</i> [Bull. ex Juss. 1789]	555, 607	[14, 645]
<i>auricularis</i> , <i>Tremella</i> [Fr.:Fr. 1830]	588	[-]
<i>auriculatum</i> , <i>Hydnum</i> [Fr. 1838, sp. nov.]	513	[618 as <i>Tremellodon auriculatum</i>]
<i>auriformis</i> , <i>Exidia</i> [(Schwein.:Fr.) Fr. 1822]	590	[-]
= <i>Peziza auriformis</i> Schwein.:Fr. 1822		
<i>auriscalpium</i> , <i>Hydnum</i> [L.:Fr. 1753]	511	[607]
<i>auriscalpium</i> , <i>Polyporus</i> [Pers. 1827]	443	[-]
<i>australis</i> , <i>Polyporus</i> [Fr.:Fr. 1828]	464	[556]
<i>avellanum</i> , <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	551	[642]
= <i>Thelephora avellana</i> Fr.:Fr. 1821		
B		
<i>badius</i> , <i>Boletus</i> [(Fr.:Fr.) Fr. 1828]	411	[499]
= <i>Boletus castaneus</i> β <i>B. badius</i> Fr.:Fr. 1821		
<i>barba-jobi</i> , <i>Odontia</i>		
[(Bull.:Fr.) Fr. 1838, comb. nov., 'barba-jovis']	528	[627 'barba-jovis']
= <i>Hydnum barba-jobi</i> Bull.:Fr. 1791		
<i>barba-jovis</i> [sic], <i>Odontia</i> – See <i>barba-jobi</i> , <i>Odontia</i>		
<i>barbirussa</i> , <i>Hydnum</i> [Kunze:Fr. 1830]	514	[-]

Taxon	Page	[Hym. Eur. page]
benzoina , <i>Trametes</i> [(Wahlenb.:Fr.) Fr. 1838, comb. nov.]	489	[554 as <i>Polyporus resinosis</i> * <i>benzoinus</i>]
= <i>Boletus benzoinus</i> Wahlenb.:Fr. 1826		
= <i>Polyporus benzoinus</i> (Wahlenb.:Fr.) Fr. 1828		
betulinus , <i>Polyporus</i> [(Bull.:Fr.) Fr. 1815]	461	[555]
= <i>Boletus betulinus</i> Bull.:Fr. 1787–88		
beyrichii , <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	558	[–]
= <i>Thelephora beyrichii</i> Fr.:Fr. 1830		
beyrichii , <i>Trametes</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	491	[–]
= <i>Polyporus beyrichii</i> Fr.:Fr. 1830		
bicolor , <i>Hydnum</i> [Alb. & Schwein.:Fr. 1805]	518	[615]
bicolor , <i>Stereum</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	549	[640]
= <i>Thelephora bicolor</i> Pers.:Fr. 1801		
biennis , <i>Polyporus</i> [(Bull.:Fr.) Fr. 1838, comb. nov.]	433	[529]
= <i>Boletus biennis</i> Bull.:Fr. 1790		
biennis , <i>Thelephora</i> [Fr.:Fr. 1821]	540	[636]
biformis , <i>Polyporus</i> [Klotzsch 1833]	475	[–]
biparasitica , <i>Tremella</i> [Fr.:Fr. 1822]	590	[–]
bivalvis , <i>Polyporus</i> [Pers. 1827]	480	[–]
Boletus [Fr.:Fr. 1821]	408, 603	[10, 495]
boltonii , <i>Corticium</i> [Fr. 1838, sp. nov.]	558	[647]
bombycina , <i>Thelephora</i> [Sommerf.:Fr. 1826]	544	[659 sub <i>Corticium serum</i>]
bombycinus , <i>Polyporus</i> [Fr.:Fr. 1828]	483	[575]
borealis , <i>Polyporus</i> [Fr.:Fr. 1821]	459	[552]
boryanum , <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	547	[–]
= <i>Thelephora boryana</i> Fr.:Fr. 1830		
botrytes [sic], <i>Clavaria</i> – See <i>botrytis</i> , <i>Clavaria</i>		
botrytes [sic], <i>Radulum</i> – See <i>botrytis</i> , <i>Radulum</i>		
botrytis [' <i>botrytes</i> '], <i>Clavaria</i> [Pers.:Fr. 1797]	571	[667 ' <i>botrytes</i> ']
botrytis [' <i>botrytes</i> '], <i>Radulum</i> [Fr.:Fr. 1828]	526	[624 ' <i>botrytes</i> ']
boucheanus , <i>Polyporus</i> [(Klotzsch) Fr. 1838, comb. nov.]	438	[533]
= <i>Favolus boucheanus</i> Klotzsch 1833		
boveanum , <i>Hydnum</i> [Mont. 1835]	513	[–]
bovinus , <i>Boletus</i> [L.:Fr. 1753]	411	[499]
brasiliensis , <i>Favolus</i> [(Fr.:Fr.) Fr. 1828]	498	[–]
= <i>Daedalea brasiliensis</i> Fr.:Fr. 1821		
brassicaefolius [sic], <i>Merulius</i> – See <i>brassicifolius</i> , <i>Merulius</i>		
brassicifolius [' <i>brassicaefolius</i> '], <i>Merulius</i> [Schwein.:Fr. 1822]	502	[–]
brumalis , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1818]	430	[526]
= <i>Boletus brumalis</i> Pers.:Fr. 1794		
bufonia , ? <i>Thelephora</i> [Pers.:Fr. 1801]	545	[645 as " <i>Th. bufonia</i> "]
bulbosa , † <i>Clavaria</i> [Schumach. 1803]	577	[674]
bulliardi [sic], <i>Trametes</i> – See <i>bulliardii</i> , <i>Trametes</i>		
bulliardii , <i>Trametes</i> [Fr. 1838, nom. nov., ' <i>bulliardi</i> ']	491	[584 ' <i>bulliardi</i> ']
= <i>Boletus suaveolens</i> Bull.:Fr. 1787–88, non L.:Fr. 1753		
= <i>Daedalea suaveolens</i> (Bull.:Fr.) Pers. 1801		

Taxon	Page	[Hym. Eur. page]
<i>bulbosus</i> , <i>Polyporus</i> [Fr. ex Weinm. 1826]	486	[579]
<i>byssiseda</i> , <i>Clavaria</i> [Pers.:Fr. 1796]	576	[673]
<i>byssoides</i> , <i>Thelephora</i> [Pers.:Fr. 1801]	541	[659 as <i>Corticium byssoidium</i>]

C

caeruleum, *Corticium*

[(Lam.:Fr.) Fr. 1838, comb. nov., 'caeruleum']	562	[651]
= <i>Byssus caerulea</i> Lam.:Fr. 1779		

caeruleum ['caeruleum'], *Hydnum suaveolens* var.

[(Hornem.:Fr.) Fr. 1821]	507	[602]
= <i>Hydnum caeruleum</i> Hornem.:Fr. 1808		

<i>caesia</i> , <i>Thelephora</i> [(Pers.:Fr.) Pers. 1801]	541	[638]
= <i>Corticium caesium</i> Pers.:Fr. 1796		

<i>caesium</i> , <i>Agyrium</i> [Fr.:Fr. 1822]	593	[-]
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<i>caesius</i> , <i>Dacrymyces</i> [Sommerf.:Fr. 1826]	592	[699]
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<i>caesius</i> , <i>Polyporus</i> [(Schr.:Fr.) Fr. 1821]	454	[547]
= <i>Boletus caesius</i> Schrad.:Fr. 1794		

<i>calceum</i> , <i>Corticium</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	562	[652]
= <i>Thelephora calcea</i> Pers.:Fr. 1801		

<i>caliciiformis</i> , <i>Crinula</i> [Fr.:Fr. 1821]	584	[-]
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<i>callosus</i> , <i>Polyporus</i> [Fr.:Fr. 1821]	485	[577]
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<i>Calocera</i> [(Fr.:Fr.) Fr. 1825]	580, 607	[15, 679]
= <i>Clavaria</i> subgen. <i>Calocera</i> Fr.:Fr. 1821		

<i>calopus</i> , <i>Boletus</i> [Pers.:Fr. 1801]	416	[506]
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<i>canadensis</i> , <i>Favolus</i> [Klotzsch:Fr. 1832]	499	[-]
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<i>canaliculata</i> , <i>Clavaria</i> [Fr.:Fr. 1818]	579	[678]
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<i>canalium</i> , [†] <i>Polyporus</i> [(Lour.) Fr. 1838, comb. nov.]	437	[-]
= <i>Boletus canalium</i> Lour. 1790		

[Fries 1832, p. 56, cited: '[BOLETUS] *canalium* Lour. (Polyp.)', which could be interpreted as creating a comb. nov. in *Polyporus*.]

<i>candicans</i> , <i>Hydnum</i> [Fr. 1838, sp. nov.]	510	[606]
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<i>candida</i> , <i>Clavaria</i> [Weinm. 1832]	580	[679]
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<i>candida</i> , <i>Thelephora</i> [(Schwein.:Fr.) Fr. 1828]	538	[-]
non <i>Thelephora candida</i> Schwein.:Fr. 1822		

 = *Merisma candidum* Schwein.:Fr. 1822

<i>candidum</i> , <i>Hydnum</i> [J.C.Schmidt:Fr. 1817]	506	[601]
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<i>candidum</i> , <i>Stereum</i> [(Schwein.:Fr.) Fr. 1832, comb. nov.]	552	[-]
= <i>Thelephora candida</i> Schwein.:Fr. 1822, non (Schwein.:Fr.) Fr. 1828		

<i>candidus</i> , <i>Irpex</i> [(Ehrenb.) Weinm. 1836]	523	[622]
= <i>Sistotrema candidum</i> Ehrenb. 1818		

<i>candidus</i> , <i>Polyporus</i> [(Roth) Fr. 1838, comb. nov.]	449	[541]
nom. illegit., non <i>Polyporus candidus</i> Pers. 1825		

 = *Boletus candidus* Roth 1797

<i>canescens</i> , <i>Irpex</i> [Fr. 1838, sp. nov.]	522	[621]
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<i>cantharellus</i> , <i>Craterellus</i> [(Schwein.:Fr.) Fr. 1838, comb. nov.]	534	[-]
= <i>Thelephora cantharella</i> Schwein.:Fr. 1822		

Taxon	Page	[Hym. Eur. page]
<i>capula</i> , <i>Cyphella</i> [(Holmsk.:Fr.) Fr. 1838, comb. nov.]	568	[664]
= <i>Peziza capula</i> Holmsk.:Fr. 1781		
<i>caput-medusae</i> , <i>Hydnum</i> [(Bull.:Fr.) Pers. 1801]	512	[608]
= <i>Clavaria caput-medusae</i> Bull.:Fr. 1789		
<i>carbonarius</i> , <i>Polyporus</i> [Fr.:Fr. 1821]	436	[532]
<i>carneoalbus</i> , <i>Irpex</i> [Fr. 1838, sp. nov.]	521	[620]
<i>carneum</i> , ? <i>Geoglossum</i> [Schultz:Fr. 1806]	583	[-]
<i>carneus</i> , <i>Irpex</i> ? [(Fr.:Fr.) Fr. 1828]	524	[622]
= <i>Sistotrema carneum</i> Fr.:Fr. 1818		
= <i>Hydnum carneum</i> (Fr.:Fr.) Fr. 1821		
<i>carneus</i> , <i>Polyporus</i> [Blume & T.Nees:Fr. 1826]	471	[563]
<i>carpineus</i> , <i>Polyporus adustus</i> var. [(Sowerby) Pers. 1825] . . .	456	[550]
= <i>Boletus carpineus</i> Sowerby 1798-99		
<i>cartilagineum</i> , <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	545	[-]
= <i>Thelephora cartilaginea</i> Fr.:Fr. 1828		
<i>caryophyllaea</i> [sic], <i>Thelephora</i> – See <i>caryophyllea</i> , <i>Thelephora</i>		
<i>caryophyllea</i> [' <i>caryophyllaea</i> '], <i>Thelephora</i>		
[(Schaff.:Fr.) Pers. 1801]	536	[634]
= <i>Helvella caryophyllea</i> Schaff. 1774		
<i>casearius</i> , <i>Polyporus</i> [Fr. 1838, sp. nov.]	449	[541]
<i>castaneus</i> , <i>Boletus</i> [Bull.:Fr. 1787-88]	426	[517]
<i>castaneus</i> , <i>Polyporus</i> [Fr.:Fr. 1821]	471	[564]
<i>cati</i> , <i>Auricularia</i> [Willd. ex Fr. 1838, nom. nov.]	555	[-]
= <i>Thelephora auricula-cati</i> Fr.:Fr. 1830		
<i>cavipes</i> , <i>Boletus</i> [Klotzsch ex Fr. 1835]	413	[520]
<i>centrifugum</i> , <i>Stereum</i> [(Weinm.) Fr. 1838, comb. nov.]	554 ['553']	[658 as <i>Corticium centrifugum</i>]
= <i>Thelephora centrifuga</i> Weinm. 1836		
<i>cervinus</i> , <i>Polyporus</i> [(Schwein.:Fr.) Steud. 1824]	474	[-]
= <i>Boletus cervinus</i> Schwein.:Fr. 1822		
<i>chailletii</i> , <i>Stereum</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	551	[642]
= <i>Thelephora chailletii</i> Pers.:Fr. 1822		
<i>chalybaea</i> [sic], <i>Thelephora</i> – See <i>chalybea</i> , <i>Thelephora</i>		
<i>chalybea</i> [' <i>chalybaea</i> '], <i>Thelephora</i> [(Pers.) Pers. 1801]	543	[660 as <i>Corticium 'chalybaeum']</i>
= <i>Corticium chalybeum</i> Pers. 1800, ' <i>chalybaeum</i> '		
<i>chartaceum</i> , <i>Stereum</i> [(G.Mey.:Fr.) Fr. 1838, comb. nov.] . . .	546	[-]
= <i>Thelephora chartacea</i> G.Mey.:Fr. 1818		
<i>chioneus</i> , <i>Polyporus</i> [Fr.:Fr. 1815]	453	[546]
<i>chrysenteron</i> [' <i>chrysentheron</i> '], <i>Boletus</i> [Bull. 1791]	415	[502]
<i>chrysenteron</i> [sic], <i>Boletus</i> – See <i>chrysenteron</i> , <i>Boletus</i>		
<i>ciliatum</i> , <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	558	[653]
= <i>Thelephora ciliata</i> Fr.:Fr. 1828		
<i>ciliatus</i> , <i>Polyporus</i> [Fr.:Fr. 1815]	431	[527]
<i>cinerascens</i> , <i>Polyporus</i> [(Schwein.) Steud. 1824]	481	[-]
= <i>Boletus cinerascens</i> Schwein. 1822		
<i>cinerea</i> , <i>Clavaria</i> [(Bull.:Fr.) Bull. 1791]	572	[668]
= <i>Clavaria coralloides</i> var. <i>cinerea</i> Bull.:Fr. 1788		

Taxon	Page	[Hym. Eur. page]
<i>cinerea</i> , <i>Daedalea</i> [Fr.:Fr. 1815]	494	[588]
<i>cinereobadium</i> , <i>Stereum</i> [Fr. 1838, nom. nov.]	547	[-]
= <i>Thelephora badia</i> Hook.:Fr. 1822		
<i>cinereum</i> , <i>Corticium</i> [Pers.:Fr. 1794]	563	[654]
= <i>Thelephora cinerea</i> (Pers.:Fr.) Pers. 1801		
<i>cinereum</i> , <i>Hydnum</i> [Bull.:Fr. 1789]	508	[604]
<i>cingulatus</i> , <i>Polyporus</i> [Fr.:Fr. 1830]	476	[-]
<i>cinnabarina</i> , <i>Daedalea</i>		
[Secr. ex Fr. 1838, sp. nov., 'cinnabarrina']	493	[587]
= <i>Daedalea cinnabarina</i> Secr. 1833, nom. inval.		
<i>cinnabarinum</i> ['cinnabarrinum'], <i>Hydnum</i>		
[(Schwein.:Fr.) Fr. 1828]	517	[615]
= <i>Sistotrema cinnabarinum</i> Schwein.:Fr. 1822		
<i>cinnabarinus</i> ['cinnabarrinus'], <i>Polyporus</i>		
[(Jacq.:Fr.) Fr. 1821]	473	[583 as <i>Trametes</i> <i>cinnabarina</i>]
= <i>Boletus cinnabarinus</i> Jacq.:Fr. 1776		
<i>cinnabarrina</i> [sic], <i>Daedalea</i> – See <i>cinnabarina</i> , <i>Daedalea</i>		
<i>cinnabarrinum</i> [sic], <i>Hydnum</i> – See <i>cinnabarinum</i> , <i>Hydnum</i>		
<i>cinnabarrinus</i> [sic], <i>Polyporus</i> – See <i>cinnabarinus</i> , <i>Polyporus</i>		
<i>cinnamomeum</i> , <i>Corticium</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	561	[650]
= <i>Thelephora cinnamomea</i> Pers.:Fr. 1822		
<i>cinnamomeus</i> , <i>Irpex</i> [Fr. 1838, sp. nov.]	524	[-]
<i>cinnamomeus</i> , [†] <i>Polyporus</i> [(Jacq.) Pers. 1825]	429	[524]
= <i>Boletus cinnamomeus</i> Jacq. 1786		
<i>cinnamomeus</i> , <i>Polyporus</i> [Trog 1832]	468	[561]
nom. illegit., non <i>Polyporus cinnamomeus</i> (Jacq.) Pers. 1825		
<i>circinatum</i> , <i>Corticium</i> [(Ehrenb.:Fr.) Fr. 1838, comb. nov.]	566	[-]
= <i>Sarcopodium circinatum</i> Ehrenb.:Fr. 1818		
= <i>Thelephora circinata</i> (Ehrenb.:Fr.) Fr. 1828		
<i>cirrhatum</i> , <i>Hydnum</i> [Pers.:Fr. 1794]	513	[609]
<i>cladonia</i> , <i>Thelephora</i> [(Schwein.:Fr.) Fr. 1828]	537	[-]
= <i>Merisma cladonia</i> Schwein.:Fr. 1822		
<i>clathroides</i> , <i>Hydnum</i> [Pall.:Fr. 1773]	511	[-]
<i>Clavaria</i> [Fr.:Fr. 1821]	571, 607	[15, 666]
<i>clavata</i> , <i>Tremella</i> [(Pers.:Fr.) Pers. 1801]	589	[-]
= <i>Acrospermum clavatum</i> Pers.:Fr. 1797		
<i>clavatus</i> , <i>Craterellus</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	533	[632]
= <i>Merulius clavatus</i> Pers.:Fr. 1796		
= <i>Cantharellus clavatus</i> (Pers.:Fr.) Fr. 1821		
<i>clavularis</i> , <i>Thelephora</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	537	[634]
= <i>Merisma clavulare</i> Fr.:Fr. 1815		
= <i>Thelephora palmata</i> γ <i>clavularis</i> (Fr.:Fr.) Fr. 1821		
<i>coccinea</i> , <i>Pistillaria</i> [(Corda) Fr. 1838, comb. nov.]	587	[687 as <i>Pistillaria</i> <i>micans</i> * <i>coccinea</i>]
= <i>Scleromitra coccinea</i> Corda 1829		
<i>coccineus</i> , † <i>Boletus</i> [Plum. ex Fr. 1838, sp. nov.]	423	[-]
nom. illegit., non <i>Boletus coccineus</i> Bull. 1791		

Taxon	Page	[Hym. Eur. page]
<i>cochleatus</i> , <i>Craterellus</i> [Fr. 1838, sp. nov.]	534	[632]
coeruleum [sic], <i>Corticium</i> – See <i>caeruleum</i> , <i>Corticium</i>		
coeruleum [sic], <i>Hydnum suaveolens</i> – See <i>caeruleum</i> , <i>Hydnum suaveolens</i>		
<i>collinitus</i> , <i>Boletus</i> [Fr. 1838, sp. nov.]	410	[498]
<i>comedens</i> , <i>Corticium</i> [(Nees:Fr.) Fr. 1838, comb. nov.]	565	[656]
= <i>Thelephora comedens</i> Nees:Fr. 1816–17		
<i>compactum</i> , <i>Hydnum</i> [Pers.:Fr. 1800]	507	[603]
<i>complicatum</i> , <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	548	[–]
= <i>Thelephora complicatum</i> Fr.:Fr. 1828		
<i>conchatum</i> , <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	549	[640]
= <i>Thelephora conchata</i> Fr.:Fr. 1821		
<i>conchatus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1821]	467	[560]
= <i>Boletus conchatus</i> Pers.:Fr. 1796		
<i>conchifer</i> , <i>Polyporus</i> [(Schwein.:Fr.) Fr. 1828]	463	[–]
= <i>Boletus conchifer</i> Schwein.:Fr. 1822		
<i>concinus</i> , <i>Polyporus</i> [(P.Beauv.:Fr.) Fr. 1821]	436	[–]
= <i>Microporus concinns</i> P.Beauv.:Fr. 1806		
<i>concrescens</i> , <i>Polyporus</i> [Mont. 1835]	474	[–]
<i>condensata</i> , <i>Clavaria</i> [Fr. 1838, sp. nov.]	575	[672]
= <i>Clavaria muscoides</i> sensu Sowerby 1798–99, non L. 1753, nec Bull. 1788		
<i>confluens</i> , <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	564	[655]
= <i>Thelephora confluens</i> Fr.:Fr. 1815		
<i>confluens</i> , <i>Merulius</i> [Schwein.:Fr. 1822]	500	[–]
<i>confluens</i> , <i>Polyporus</i> [(Alb. & Schwein.:Fr.) Fr. 1821]	447	[539]
= <i>Boletus confluens</i> Alb. & Schwein.:Fr. 1805		
<i>confluens</i> , <i>Sistotrema</i> [Pers.:Fr. 1794]	520	[619]
<i>confragosa</i> , <i>Daedalea</i> [(Bolton:Fr.) Pers. 1801]	493	[587]
= <i>Boletus confragosus</i> Bolton:Fr. 1792		
<i>connatum</i> , <i>Hydnum</i> [Schultz:Fr. 1806]	509	[605]
<i>connatus</i> , <i>Polyporus</i> [Weinm.:Fr. 1826]	472	[563]
<i>conspersus</i> , <i>Hypochnus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	570	[–]
= <i>Thelephora conspersa</i> Fr.:Fr. 1830		
<i>contiguus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1821]	483	[571]
= <i>Boletus contiguus</i> Pers.:Fr. 1801		
<i>contorta</i> , <i>Clavaria</i> [Holmsk.:Fr. 1790]	579	[677]
<i>contorta</i> , <i>Phlebia</i> [Fr.:Fr. 1821]	526	[625]
<i>Cora</i> [Fr. 1825]	556, 607	[–]
<i>coralloides</i> , <i>Clavaria</i> [L.:Fr. 1753]	572	[668]
<i>coralloides</i> , <i>Hydnum</i> [Scop.:Fr. 1772]	511	[607]
<i>coralloides</i> , <i>Thelephora</i> [Fr.:Fr. 1821]	537	[634]
<i>corium</i> , <i>Merulius</i> [(Pers.:Fr.) Fr. 1828]	500	[591]
= <i>Thelephora corium</i> Pers.:Fr. 1801		
<i>cornea</i> , <i>Calocera</i> [(Batsch:Fr.) Fr. 1832]	581	[680]
= <i>Clavaria cornea</i> Batsch:Fr. 1783		
<i>cornea</i> , <i>Exidia</i> [(Ehrenb.:Fr.) Fr. 1822]	590	[–]
= <i>Auricularia cornea</i> Ehrenb.:Fr. 1820		

Taxon	Page	[Hym. Eur. page]
<i>cornucopioides</i> , <i>Craterellus</i> [(L.:Fr.) Pers. 1825]	532	[631]
= <i>Peziza cornucopioides</i> L.:Fr. 1753		
= <i>Cantharellus cornucopioides</i> (L.:Fr.) Fr. 1821		
<i>corrugata</i> , <i>Daedalea discolor</i> var.		
[(Klotzsch) Fr. 1838, comb. nov.]	494	[-]
= <i>Daedalea corrugata</i> Klotzsch 1833		
<i>corrugatum</i> , <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	565	[656]
= <i>Thelephora corrugata</i> Fr.:Fr. 1815		
<i>corrugatum</i> , <i>Hydnum</i> [Fr.:Fr. 1818]	512	[609]
<i>corticalis</i> , <i>Calocera</i> [(Batsch:Fr.) Fr. 1828]	581	[680]
= <i>Clavaria corticalis</i> Batsch:Fr. 1786		
<i>Corticium</i> [Pers. 1794]	556, 607	[14, 646]
<i>corticola</i> , <i>Polyporus</i> [Fr.:Fr. 1821]	488	[580]
<i>cotyledoneum</i> , <i>Stereum</i> [(Fr. ex Weinm.) Fr. 1838, comb. nov.]	551	[642]
= <i>Thelephora cotyledonea</i> Fr. ex Weinm. 1836		
<i>crassus</i> , <i>Polyporus</i> [Fr. 1838, sp. nov.]	451	[543]
<i>Craterellus</i> [Pers. 1825]	531, 606	[14, 630]
<i>crenata</i> , <i>Exidia</i> [(Schwein.:Fr.) Fr. 1822]	591	[-]
= <i>Tremella crenata</i> Schwein.:Fr. 1822		
<i>crinale</i> , <i>Hydnum</i> [Fr. 1838, sp. nov.]	516	[613]
<i>crinigera</i> , <i>Hexagonia</i> [Fr. 1838, sp. nov.]	496	[-]
= 'Fung. Guin. f. 10' [ined.]		
<i>crinitum</i> , <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	557	[-]
= <i>Thelephora crinita</i> Fr.:Fr. 1830		
<i>Crinula</i> [Fr.:Fr. 1821]	584, 608	[15, 681]
<i>crispa</i> , <i>Sparassis</i> [(Wulfen:Fr.) Fr. 1821]	570	[666]
= <i>Clavaria crispa</i> Wulfen:Fr. 1781		
<i>crispata</i> , <i>Mitrula</i> [Fr. 1838, nom. nov.]	583	[-]
= <i>Spathularia flavida</i> d) <i>undulata</i> Fr. 1821		
<i>crispatus</i> , <i>Merulius</i> [O.F.Müll.:Fr. 1777]	502	[593]
<i>crispula</i> , <i>Clavaria</i> [Fr.:Fr. 1821]	576	[673]
<i>crispum</i> , <i>Sistotrema</i> [Fr.:Fr. 1830]	520	[-]
<i>crispus</i> , <i>Craterellus sinuosus</i> var. [(Bull.) Fr. 1838, comb. nov.]	533	[631 as <i>Craterellus</i>
= <i>Helvella crispa</i> Bull. 1790, non (Scop.:Fr.) Fr. 1822		<i>crispus</i>]
<i>crispus</i> , <i>Irpex</i> [(Schaeff.:Fr.) Fr. 1838, comb. nov.]	521	[620 sub <i>Irpex</i>
= <i>Hydnum crispum</i> Schaeff.:Fr. 1774		<i>pendulus</i>]
<i>crispus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1821]	457	[550]
= <i>Boletus crispus</i> Pers.:Fr. 1800		
<i>cristata</i> , <i>Clavaria</i> [(Holmsk.:Fr.) Pers. 1801]	572	[668]
= <i>Ramaria cristata</i> Holmsk.:Fr. 1790		
= <i>Clavaria fallax</i> Pers. 1795		
= <i>Clavaria fallax</i> a <i>cristata</i> (Holmsk.:Fr.) Pers. 1797		
<i>cristata</i> , <i>Thelephora</i> [(Pers.:Fr.) Fr. 1821]	539	[637]
= <i>Merisma cristatum</i> Pers.:Fr. 1797		
<i>cristatus</i> , <i>Polyporus</i> [(Schaeff.:Fr.) Fr. 1821]	447	[539]
= <i>Boletus cristatus</i> Schaeff.:Fr. 1774		

Taxon	Page	[Hym. Eur. page]
<i>cristulata</i> , <i>Odontia</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	529	[628]
= <i>Hydnum cristulatum</i> Fr.:Fr. 1821		
<i>crocatum</i> , <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	550	[641]
= <i>Thelephora crocata</i> Fr.:Fr. 1828		
<i>crocatus</i> , <i>Polyporus</i> [Fr. 1838, sp. nov.]	477	[-]
<i>crocea</i> , ? <i>Clavaria</i> [Pers.:Fr. 1797]	575	[671]
<i>crocea</i> , <i>Thelephora</i> [Schröd. ex J.F.Gmel. 1792]	554 ['553']	[645]
<i>croceum</i> , <i>Hydnum</i> [(Schwein.:Fr.) Fr. 1828]	516	[-]
= <i>Sistotrema croceum</i> Schwein.:Fr. 1822		
<i>croceus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1815]	454	[548]
= <i>Boletus croceus</i> Pers.:Fr. 1796		
<i>crustacea</i> , <i>Thelephora</i> [Schumacher:Fr. 1803]	541	[637]
<i>crustosa</i> , <i>Grandinia</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	528	[627]
= <i>Odontia crustosa</i> Pers.:Fr. 1800		
= <i>Hydnum crustosum</i> (Pers.:Fr.) Pers. 1801		
<i>cryptarum</i> , <i>Polyporus</i> [(Bull.:Fr.) Fr. 1821]	474	[566]
= <i>Boletus cryptarum</i> Bull.:Fr. 1790		
<i>cubensis</i> , <i>Polyporus</i> [Mont. 1837]	462	[-]
<i>cucullata</i> , <i>Mitrula</i> [(Batsch:Fr.) Fr. 1838, comb. nov.]	584	[-]
= <i>Helvella cucullata</i> Batsch:Fr. 1786		
= <i>Geoglossum cucullatum</i> (Batsch:Fr.) Fr. 1828		
<i>culmigena</i> , <i>Pistillaria</i> [Mont. & Fr. 1836]	587	[687]
<i>cupressi</i> , <i>Cyphella</i> [(Schwein.:Fr.) Fr. 1828]	567	[-]
= <i>Merulius cupressi</i> Schwein.:Fr. 1822		
<i>curtum</i> , <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	545	[-]
= <i>Thelephora curta</i> Fr.:Fr. 1830		
<i>cuticularis</i> , <i>Polyporus</i> [(Bull.:Fr.) Fr. 1821]	458	[551]
= <i>Boletus cuticularis</i> Bull.:Fr. 1790		
<i>cyanescens</i> , <i>Boletus</i> [Bull.:Fr. 1788]	426	[517]
<i>cyathiforme</i> , <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	545	[-]
= <i>Thelephora cyathiformis</i> Fr.:Fr. 1830		
<i>cyathoides</i> , <i>Polyporus melanopus</i> var. [(Sw.:Fr.) Fr. 1821]	439	[534]
= <i>Boletus melanopus</i> var. <i>cyathoides</i> Sw.:Fr. 1810		
<i>Cyclomyces</i> [Kunze 1830]	495, 605	[589]
<i>cyclothelis</i> , <i>Stereum</i> [(Pers.) Fr. 1838, comb. nov.]	554 ['553']	[645]
= <i>Thelephora cyclothelis</i> Pers. 1822		
<i>Cyphella</i> [Fr.:Fr. 1822]	566, 607	[15, 661]
<i>cyphella</i> , <i>Guepinia</i> ? [Fr. 1838, nom. nov.]	566	[697]
= <i>Cyphella friesii</i> Weinm. 1836		

D

<i>Dacrymyces</i> [Nees:Fr. 1816–17]	592 'Darcrymyces', 608	[16, 697]
<i>Daedalea</i> [Pers.:Fr. 1801]	492, 605	[12, 586]
<i>damaecorne</i> [sic], <i>Stereum</i> – See <i>damicornis</i> , <i>Stereum</i>		
<i>damicornis</i> ['damaecorne'], <i>Stereum</i> [Link:Fr. 1809]	546	[-]
= <i>Thelephora damicornis</i> (Link:Fr.) Fr. 1830		

Taxon	Page	[Hym. Eur. page]
Darcrymyces [sic] – See <i>Dacrymyces</i>		
<i>deformis</i> , <i>Irpex</i> [Fr.:Fr. 1828]	523	[622]
= <i>Hydnum pseudoboletus</i> DC.:Fr. 1815		
<i>deformis</i> , <i>Polyporus</i> [(Schaeff.) Fr. 1838, comb. nov.]	441	[536]
= <i>Boletus deformis</i> Schaeff. 1774		
<i>delicata</i> , <i>Calocera</i> [Fr.:Fr. 1830]	581	[–]
<i>delicata</i> , <i>Clavaria</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	573	[670]
= <i>Clavaria subtilis</i> β <i>C. delicata</i> Fr.:Fr. 1821		
<i>delicata</i> , <i>Laschia</i> [Fr.:Fr. 1830]	499	[–]
<i>delicatulum</i> , <i>Hydnum</i> [Klotzsch ex Fr. 1838, sp. nov.]	515	[–]
<i>dendritica</i> , <i>Thelephora</i> [Pers. 1827]	536	[–]
<i>destructor</i> , <i>Polyporus</i> [(Schr.:Fr.) Fr. 1821]	454	[547]
= <i>Boletus destructor</i> Schrad.:Fr. 1794		
<i>detonsus</i> , <i>Polyporus</i> [Fr.:Fr. 1830]	479	[–]
<i>dialeptus</i> , <i>Polyporus</i> [Fr. 1838, sp. nov.]	456	[–]
= ‘ <i>Fung. Guin. c. ic</i> ’ [ined.]		
<i>diaphana</i> , <i>Pistillaria</i> [(Schumach.:Fr.) Fr. 1821]	586	[688]
= <i>Clavaria diaphana</i> Schumach.:Fr. 1803		
<i>diaphanum</i> , <i>Hydnum</i> [Schr.:Fr. 1794]	518	[616]
<i>dichrous</i> , <i>Polyporus</i> [Fr.:Fr. 1815]	457	[550]
<i>dictiopis</i> [sic], <i>Polyporus</i> – See <i>dictyopus</i> , <i>Polyporus</i>		
<i>dictyopus</i> [‘ <i>dictiopis</i> ’], <i>Polyporus</i> [Mont. 1835]	440	[–]
<i>difforme</i> , <i>Geoglossum</i> [Fr.:Fr. 1815]	583	[–]
<i>diffusa</i> , <i>Thelephora palmata</i> var. [Fr.:Fr. 1821]	537	[635 as <i>Thelephora diffusa</i>]
<i>digitalis</i> , <i>Cyphella</i> [(Alb. & Schwein.:Fr.) Fr. 1822]	567	[662]
= <i>Peziza digitalis</i> Alb. & Schwein.:Fr. 1805		
<i>digitata</i> , <i>Thelephora palmata</i> var.		
[(Schumach.) Fr. 1838, comb. nov.]	537	[634 sub <i>Thelephora anthocephala</i>]
= <i>Clavaria digitata</i> Schumach. 1803		
= <i>Thelephora palmata</i> γ Fr. 1828		
<i>disciforme</i> , <i>Stereum</i> [(DC.:Fr.) Fr. 1838, comb. nov.]	551	[642]
= <i>Thelephora disciformis</i> DC.:Fr. 1815		
<i>discolor</i> , <i>Daedalea</i> [Fr.:Fr. 1828]	494	[–]
<i>discolor</i> , <i>Hydnum</i> [Fr.:Fr. 1821]	513	[–]
<i>discolor</i> , <i>Polyporus</i> [Klotzsch 1833]	450	[–]
<i>distortus</i> , <i>Polyporus</i> [(Schwein.:Fr.) Fr. 1828]	449	[–]
= <i>Boletus distortus</i> Schwein.:Fr. 1822		
= <i>Daedalea biennis</i> (Pers.:Fr.) Fr. 1821 [fide Schwein. 1832, p. 160]		
<i>diversidens</i> , <i>Hydnum</i> [Fr.:Fr. 1821]	513	[609]
<i>domestica</i> , † <i>Thelephora</i> [(Pers.:Fr.) Fr. 1821]	543	[–]
= <i>Himantia domestica</i> Pers.:Fr. 1801		
<i>drummondii</i> , <i>Polyporus</i> [Klotzsch 1833]	481	[–]
<i>dryadeus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1821]	460	[553]
= <i>Boletus dryadeus</i> Pers.:Fr. 1800		

Taxon	Page	[Hym. Eur. page]
F		
<i>fagineum</i> , <i>Radulum</i> [(Pers.:Fr.) Fr. 1828]	525	[624]
= <i>Sistotrema fagineum</i> Pers.:Fr. 1801		
= <i>Hydnum fagineum</i> (Pers.:Fr.) Fr. 1821		
<i>falcata</i> , <i>Clavaria</i> [Pers.:Fr. 1794]	580	[678]
<i>fallax</i> , <i>Hydnum</i> [(Fr.:Fr.) Fr. 1821]	517	[614]
= <i>Sistotrema fallax</i> Fr.:Fr. 1814		
<i>farinaceum</i> , <i>Geoglossum</i> [Schwein.:Fr. 1822]	583	[-]
<i>farinaceum</i> , <i>Hydnum</i> [Pers.:Fr. 1801]	519	[616]
<i>farinaceus</i> , <i>Boletus fuliginus</i> var.		
[Secr. ex Fr. 1838, var. nov.]	419	[520 as <i>Boletus</i>
= <i>Boletus farinaceus</i> Secr. 1833, nom. inval.		<i>farinaceus</i>]
<i>farinaceus</i> , <i>Irpex</i> [Fr.:Fr. 1830]	522	[-]
<i>farinellus</i> , <i>Polyporus</i> [Fr.:Fr. 1821]	487	[579]
<i>fasciatum</i> , <i>Stereum</i> [(Schwein.:Fr.) Fr. 1838, comb. nov.]	546	[-]
= <i>Thelephora fasciata</i> Schwein.:Fr. 1822		
= <i>Thelephora versicolor</i> β <i>T. fasciata</i> (Schwein.:Fr.) Fr. 1828		
<i>fasciatus</i> , <i>Polyporus</i> [(Sw.:Fr.) Fr. 1821]	471	[-]
= <i>Boletus fasciatus</i> Sw.:Fr. 1788		
<i>fasciculare</i> , <i>Hydnum</i> [Alb. & Schwein.:Fr. 1805]	519	[629 as <i>Mucronella</i>
		<i>fascicularis</i>]
<i>fastidiosa</i> , <i>Thelephora</i> [(Pers.:Fr.) Fr. 1821]	540	[637]
= <i>Corticium foetidum</i> Pers. 1795		
= <i>Merisma fastidiosum</i> Pers.:Fr. 1797		
<i>fastigiata</i> , <i>Clavaria</i> [L. 1753]	571	[667]
<i>Favolus</i> [Fr.:Fr. 1828]	498, 605	[12, 590]
<i>feeii</i> , <i>Polyporus</i> [Fr.:Fr. 1830]	476	[-]
<i>felleus</i> , <i>Boletus</i> [Bull.:Fr. 1788]	425	[516]
<i>fernandesianus</i> ['fernadezianus'], <i>Polyporus</i> [Mont. 1835]	481	[-]
<i>fernandezianus</i> [sic], <i>Polyporus</i> – See <i>fernandesianus</i> , <i>Polyporus</i>		
<i>ferruginea</i> , <i>Daedalea</i> [Schumach.:Fr. 1803]	493	[589]
<i>ferruginea</i> , <i>Thelephora</i> [(Pers.:Fr.) Pers. 1801, p. 578]	543	[661 as <i>Corticium</i>
= <i>Corticium ferrugineum</i> Pers.:Fr. 1800		<i>ferrugineum</i>]
= <i>Hypochnus ferrugineus</i> (Pers.:Fr.) Fr. 1818		
non <i>Thelephora ferruginea</i> Pers. 1801, p. 569		
<i>ferrugineum</i> , <i>Hydnum</i> [Fr.:Fr. 1815]	508	[603]
<i>ferrugineum</i> , <i>Stereum</i> [(Bull.) Fr. 1838, comb. nov.]	550	[640]
nom. illegit., non <i>Stereum ferrugineum</i> (Pers.) Fr. 1818		
= <i>Auricularia ferruginea</i> Bull. 1788		
<i>ferruginosum</i> , <i>Hydnum</i> [Fr.:Fr. 1821]	516	[613]
<i>ferruginosus</i> , <i>Polyporus</i> [(Schr.:Fr.) Fr. 1821]	483	[571]
= <i>Boletus ferruginosus</i> Schrad.:Fr. 1792		
<i>fibrosa</i> , <i>Trametes</i> [(Hook.) Fr. 1838, comb. nov.]	490	[-]
= <i>Boletus fibrosus</i> Hook. 1822		
<i>fibula</i> , <i>Polyporus</i> [(Sowerby) Fr. 1838, comb. nov.]	475	[567]
= <i>Boletus fibula</i> Sowerby 1800–03		
<i>filiformis</i> , <i>Typhula</i> [(Bull.:Fr.) Fr. 1821]	586	[685]
= <i>Clavaria filiformis</i> Bull.:Fr. 1790		

Taxon	Page	[Hym. Eur. page]
<i>fimbriata</i> , <i>Odontia</i> [Pers.:Fr. 1796]	529	[627]
= <i>Sistotrema fimbriatum</i> (Pers.:Fr.) Pers. 1801		
= <i>Hydnum fimbriatum</i> (Pers.:Fr.) DC. 1815		
<i>fimbriata</i> , <i>Thelephora</i> [(Schwein.) Schwein. 1832]	539	[-]
nom. illegit., non <i>Thelephora fimbriata</i> Roth 1800		
= <i>Merisma fimbriatum</i> Schwein. 1822		
<i>fimbriata</i> , <i>Tremella</i> [Pers.:Fr. 1800]	588	[690]
<i>fimbriatum</i> , <i>Porothelium</i> [(Pers.:Fr.) Fr. 1818]	503	[595]
= <i>Poria fimbriata</i> Pers.:Fr. 1794		
= <i>Boletus fimbriatus</i> (Pers.:Fr.) Pers. 1801		
= <i>Polyporus Porothelium fimbriatus</i> (Pers.:Fr.) Fr. 1821		
<i>fimbriatus</i> , <i>Polyporus</i> [Fr.:Fr. 1830]	476	[-]
non <i>Polyporus fimbriatus</i> (Pers.:Fr.) Fr. 1821		
<i>Fistulina</i> [Bull.:Fr. 1791]	504, 605	[11, 522]
<i>fistulosa</i> , <i>Clavaria</i> [Holmsk.:Fr. 1790]	579	[677]
<i>flabelliformis</i> , <i>Polyporus</i> [Klotzsch 1833]	444	[-]
nom. illegit., non <i>Polyporus flabelliformis</i> Pers. 1825		
<i>flaccida</i> , <i>Clavaria</i> [Fr.:Fr. 1821]	574	[671]
<i>flaccidus</i> , <i>Favolus</i> [Fr.:Fr. 1830]	499	[-]
<i>flava</i> , <i>Clavaria</i> [Schaeff.:Fr. 1774]	571	[666]
<i>flavidus</i> , <i>Boletus</i> [Fr.:Fr. 1815]	410	[498]
<i>flavum</i> , <i>Agryrium</i> [Fr.:Fr. 1822]	593	[-]
<i>flavus</i> , <i>Boletus elegans</i> var.		
[(With.) Fr. 1838, comb. nov.]	410	[497 as <i>Boletus flavus</i>]
= <i>Boletus flavus</i> With. 1792		
<i>flavus</i> , <i>Irpex</i> [Klotzsch 1833]	522	[-]
<i>flexipes</i> , <i>Polyporus</i> [Fr.:Fr. 1830]	432	[-]
<i>floccopus</i> , <i>Boletus</i> [Vahl:Fr. 1799]	422	[513]
<i>floccosus</i> , <i>Boletus alboater</i> var.		
[(Schwein.) Fr. 1838, comb. nov.]	424	[-]
= <i>Boletus floccosus</i> Schwein. 1822		
<i>flocculentum</i> , <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	559	[647]
= <i>Thelephora flocculenta</i> Fr.:Fr. 1828		
<i>foliacea</i> , <i>Tremella</i> [Pers.:Fr. 1800]	588	[690]
<i>fomentarius</i> , <i>Polyporus</i> [(L.:Fr.) G.Mey. 1818]	465	[558]
= <i>Boletus fomentarius</i> L.:Fr. 1753		
<i>formosa</i> , <i>Clavaria</i> [Pers.:Fr. 1797]	574	[671]
<i>fornicatus</i> , <i>Polyporus</i> [Fr.:Fr. 1830]	443	[-]
<i>fraceolens</i> , <i>Hydnum</i> [Brot.:Fr. 1800]	507	[602]
<i>fragiformis</i> , <i>Dacrymyces</i> [(Pers.:Fr.) Nees 1816-17]	592	[698]
= <i>Tremella fragiformis</i> Pers.:Fr. 1801		
<i>fragile</i> , [†] <i>Hydnum</i> [Pers.:Fr. 1801]	518	[615 sub <i>Hydnum macrodon</i>]
<i>fragilis</i> , <i>Clavaria</i> [Holmsk.:Fr. 1790]	578	[675]
<i>fragilis</i> , <i>Polyporus</i> [Fr.:Fr. 1828]	453	[546]
<i>fragrans</i> , <i>Boletus</i> [Vittad. 1835]	421	[509]

Taxon	Page	[Hym. Eur. page]
<i>fraxineus</i> , <i>Polyporus</i> [(Bull.:Fr.) Fr. 1821]	470	[563]
= <i>Boletus fraxineus</i> Bull.:Fr. 1790		
<i>friesii</i> , <i>Polyporus</i> [Klotzsch 1833]	480	[-]
<i>friesii</i> , <i>Porotheleum</i> [Mont. 1836]	504	[595]
<i>frondescens</i> , <i>Thelephora</i> [Fr.:Fr. 1821]	540	[636]
<i>frondosa</i> , <i>Tremella</i> [Fr.:Fr. 1822]	588	[690]
<i>frondosus</i> , <i>Polyporus</i> [(Dicks.:Fr.) Fr. 1821]	446	[538]
= <i>Boletus frondosus</i> Dicks.:Fr. 1785		
<i>frustulatum</i>, <i>Stereum</i>		
[(Pers.:Fr.) Fr. 1838, comb. nov., ' <i>frustulosum</i> ']	552	[643 ' <i>frustulosum</i> ']
= <i>Thelephora frustulata</i> Pers.:Fr. 1801		
<i>frustulosum</i> [sic], <i>Stereum</i> – See <i>frustulatum</i> , <i>Stereum</i>		
<i>fugax</i> , <i>Merulius</i> [Fr.:Fr. 1815]	501	[593]
<i>fulgida</i> , <i>Pistillaria</i> [Fr. 1838, nom. nov.]	587	[687]
= <i>Clavaria minuta</i> Sowerby:Fr. 1800–03		
= <i>Mitrula minuta</i> (Sowerby:Fr.) Fr. 1821		
<i>fuligineoalbum</i> , <i>Hydnum</i> [J.C.Schmidt:Fr. 1817]	506	[601]
<i>fuliginus</i> , <i>Boletus</i> [Fr. 1835]	419	[514]
nom. illegit., non <i>Boletus fuliginus</i> Pers.:Fr. 1801		
<i>fuliginus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1821]	430	[525]
= <i>Boletus fuliginus</i> Pers.:Fr. 1801		
<i>fuliginosum</i>, <i>Stereum</i>		
[(Pers.) Fr. 1838, comb. nov.]	554	[553'] [645]
= <i>Thelephora fuliginosa</i> Pers. 1822		
<i>fuliginosus</i>, <i>Polyporus</i> [(Scop.) Fr. 1838, comb. nov.]	451	[543]
= <i>Boletus fuliginosus</i> Scop. 1772		
<i>fulvidus</i> , <i>Boletus</i> [Fr.:Fr. 1818]	426	[517]
= <i>Boletus cyanescens</i> β <i>B. fulvidus</i> (Fr.:Fr.) Fr. 1821		
<i>fulvus</i>, <i>Polyporus</i> [(Scop.) Fr. 1838, comb. nov.]	466	[559]
= <i>Boletus fulvus</i> Scop. 1772		
<i>fumosa</i> , <i>Clavaria</i> [Pers.:Fr. 1796]	578	[676]
<i>fumosum</i>, <i>Corticium</i> [(Fr.) Fr. 1838, comb. nov.]	562	[651]
= <i>Hypochnus fumosus</i> Fr. 1818		
<i>fumosus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1818]	456	[549]
= <i>Boletus fumosus</i> Pers.:Fr. 1801		
<i>funalis</i>, <i>Polyporus</i> [Fr. 1838, sp. nov.]	459	[-]
= ' <i>Fung. Guin. f. 3'</i> [ined.]		
<i>furcata</i> , <i>Calocera</i> [(Fr.:Fr.) Fr. 1832]	581	[680]
= <i>Clavaria furcata</i> Fr.:Fr. 1821		
<i>furcellata</i> , <i>Clavaria</i> [Fr.:Fr. 1830]	576	[-]
<i>fusca</i> , <i>Thelephora</i> [(Pers.:Fr.) Fr. 1821]	544	[651 as <i>Corticium</i>
= <i>Corticium fuscum</i> Pers.:Fr. 1796		<i>fuscum</i>]
<i>fusca</i>, <i>Trametes</i> [(Link:Fr.) Fr. 1838, comb. nov.]	490	[-]
= <i>Daedalea fusca</i> Link:Fr. 1809		
<i>fuscatus</i> , <i>Polyporus versicolor</i> var. [(Fr.:Fr.) Fr. 1821]	479	[569]
= <i>Polyporus fuscatus</i> Fr.:Fr. 1818		
<i>fuscidulus</i>, <i>Polyporus</i> [(Schrad.) Fr. 1838, comb. nov.]	431	[528]
= <i>Boletus fuscidulus</i> Schrad. 1792		

Taxon	Page	[Hym. Eur. page]
<i>fuscipes</i>, <i>Typhula</i> [(Pers.) Fr. 1838, comb. nov.]	586	[686]
= <i>Clavaria fuscipes</i> Pers. 1822		
<i>fuscoatrum</i> , <i>Hydnum</i> [Fr.:Fr. 1814]	515	[612]
<i>fuscopurpureus</i> , <i>Polyporus</i> [Pers. 1827]	465	[-]
<i>fuscoviolaceus</i> , <i>Irpex</i> [(Ehreb.:Fr.) Fr. 1828]	521	[620]
= <i>Sistotrema fuscoviolaceum</i> Ehreb.:Fr. 1818		
<i>fuscus</i> , <i>Cyclomyces</i> [Kunze:Fr. 1830]	496	[-]
<i>fusiformis</i> , <i>Clavaria</i> [Sowerby:Fr. 1798–99]	577	[674]
G		
<i>galeata</i>, <i>Cyphella</i> [(Schumach.:Fr.) Fr. 1838, comb. nov.]	567	[663]
= <i>Merulius galeatus</i> Schumach.:Fr. 1803		
<i>galeata</i> , <i>Tremella sarcoides</i> var. [(Holmsk.:Fr.) Fr. 1822]	589	[-]
= <i>Clavaria galeata</i> Holmsk.:Fr. 1790		
<i>gallica</i>, <i>Trametes</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	489	[582]
= <i>Polyporus gallicus</i> Fr.:Fr. 1821		
<i>gausapata</i> , <i>Thelephora</i> [Fr.:Fr. 1828]	538	[638 as <i>Stereum gausapatum</i>]
<i>gelatinosum</i> , <i>Hydnum</i> [Scop.:Fr. 1772]	512	[618 as <i>Tremellodon gelatinosum</i>]
<i>gelsorum</i> , † <i>Polyporus</i> [Fr.:Fr. 1821]	469	[562]
<i>Geoglossum</i> [Pers.:Fr. 1794]	582, 608	[-]
<i>gibbosa</i>, <i>Trametes</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	492	[583]
= <i>Merulius gibbosus</i> Pers.:Fr. 1796		
= <i>Daedalea gibbosa</i> (Pers.:Fr.) Pers. 1801		
<i>gibbosus</i> , <i>Polyporus</i> [Blume & T.Nees:Fr. 1826]	443	[-]
<i>gibbosus</i> , <i>Polyporus</i> [Pers. 1825]	462	[562 sub <i>Polyporus</i>
unavailable name, non <i>Polyporus gibbosus</i> Blume & T.Nees:Fr. 1826		<i>cytisinus</i>]
<i>gigantea</i> , <i>Clavaria</i> [Schwein.:Fr. 1822]	576	[-]
<i>giganteum</i>, <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	559	[648]
= <i>Thelephora gigantea</i> Fr.:Fr. 1815		
<i>giganteus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1815]	448	[540]
= <i>Boletus giganteus</i> Pers.:Fr. 1794		
<i>gilvus</i> , <i>Polyporus</i> [(Schwein.:Fr.) Fr. 1828]	455	[548]
= <i>Boletus gilvus</i> Schwein.:Fr. 1822		
<i>glabrata</i>, <i>Cora</i> [(Spreng.:Fr.) Fr. 1838, comb. nov.]	556	[-]
= <i>Thelephora glabrata</i> Spreng.:Fr. 1820		
<i>glabrum</i> , <i>Geoglossum</i> [Pers.:Fr. 1800]	582	[-]
<i>glandulosa</i> , <i>Exidia</i> [(Bull.:Fr.) Fr. 1822]	591	[694]
= <i>Tremella glandulosa</i> Bull.:Fr. 1789		
<i>globosa</i> , <i>Mitrlula</i> [Sommerf.:Fr. 1826]	584	[-]
<i>glossoides</i> , <i>Calocera</i> [(Pers.:Fr.) Fr. 1832]	582	[681]
= <i>Clavaria glossoides</i> Pers.:Fr. 1797		
<i>glossoides</i> , <i>Radulum</i> [(Pers.:Fr.) Fr. 1828]	526	[624]
= <i>Sistotrema glossoides</i> Pers.:Fr. 1825		
<i>glutinosum</i> , <i>Geoglossum</i> [Pers.:Fr. 1796]	582	[-]
<i>godbachii</i> , <i>Cyphella</i> [Weinm. 1836]	569	[665]

Taxon	Page	[Hym. Eur. page]
<i>gracile</i> , <i>Hydnum laevigatum</i> var. [Fr.:Fr. 1821]	506	[600 as <i>Hydnum gracile</i>]
<i>gracilis</i> , <i>Clavaria</i> [Pers.:Fr. 1797]	575	[672]
<i>gracillima</i> , <i>Calocera</i> [Weinm. 1836]	582	[681]
<i>Grandinia</i> [Fr. 1838, gen. nov.]	527, 606	[13, 625]
<i>granulatus</i> , <i>Boletus</i> [L.:Fr. 1753]	410	[498]
<i>granulosa</i>, <i>Grandinia</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	527	[626]
= <i>Thelephora granulosa</i> Pers.:Fr. 1801		
= <i>Hydnum granulosum</i> (Pers.:Fr.) Pers. 1825		
<i>graveolens</i> , <i>Hydnum</i> [Pers. 1825]	509	[605]
<i>graveolens</i> , <i>Polyporus</i> [(Schwein.:Fr.) Fr. 1828]	451	[-]
= <i>Boletus graveolens</i> Schwein.:Fr. 1822		
<i>grevillei</i>, <i>Typhula</i> [Fr. 1838, sp. nov.]	585	[685]
= <i>Clavaria trichopus</i> Grev. 1823, nom. illegit., non Pers.:Fr. 1797		
= <i>Clavaria setipes</i> Grev. 1823		
<i>grisea</i> , <i>Clavaria</i> [Pers.:Fr. 1797]	575	[672]
<i>griseopallida</i> , <i>Cyphella</i> [Weinm. 1836]	567	[662]
<i>Guepinia</i> [Fr.:Fr. 1825]	566, 607	[16, 697]
<i>guttatus</i>, <i>Boletus variegatus</i> var. [Fr. 1838, var. nov.]	413	[501]
= <i>Boletus guttatus</i> Pers. 1825, pro parte		
<i>gyrans</i> , <i>Typhula</i> [(Batsch:Fr.) Fr. 1821]	585	[684]
= <i>Clavaria gyrans</i> Batsch:Fr. 1786		
<i>gyrolophia</i>, <i>Cora</i> [Fr. 1838, nom. nov.]	556	[-]
= <i>Gyrolophia elegans</i> Kunze 1827		
H		
<i>helvelloides</i> , <i>Guepinia</i> [(DC.:Fr.) Fr. 1828]	566	[697]
= <i>Tremella helvelloides</i> DC.:Fr. 1805		
<i>helvelloides</i> , <i>Thelephora</i> [Schwein.:Fr. 1822]	541	[-]
<i>helvola</i>, <i>Trametes</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	490	[-]
= <i>Polyporus helvolus</i> Fr.:Fr. 1828		
<i>hepatica</i> , <i>Fistulina</i> [(Schaeff.:Fr.) With. 1792]	504	[522]
= <i>Boletus hepaticus</i> Schaeff.:Fr. 1774		
<i>hepaticum</i>, <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	550	[(641)]
= <i>Thelephora hepatica</i> Fr.:Fr. 1821		
<i>hepaticus</i> , <i>Favolus</i> [Klotzsch:Fr. 1832]	499	[-]
<i>herbarum</i> , <i>Agyrium</i> [Fr.:Fr. 1822]	593	[-]
<i>Hericum</i> [Pers. 1794]	519, 606	[13, 617]
<i>heteroclitus</i> , <i>Polyporus</i> [(Bolton:Fr.) Fr. 1821]	451	[544]
= <i>Boletus heteroclitus</i> Bolton:Fr. 1792		
Hexagona [sic] – See <i>Hexagonia</i>		
<i>Hexagonia</i> [' <i>Hexagona</i> '] [Fr. 1835]	496, 605	[12, 589 ' <i>Hexagona</i> ']
<i>himantia</i> , <i>Hydnum</i> [Schwein.:Fr. 1822]	518	[-]
<i>himantioides</i> , <i>Merulius</i> [Fr.:Fr. 1818]	501	[592]
<i>hirsutum</i> , <i>Geoglossum</i> [Pers.:Fr. 1797]	583	[-]
<i>hirsutum</i> , <i>Stereum</i> [(Willd.:Fr.) Pers. 1799]	549	[639]
= <i>Thelephora hirsuta</i> Willd.:Fr. 1787		

Taxon	Page	[Hym. Eur. page]
<i>hirsutus</i> , <i>Polyporus</i> [(Wulfen:Fr.) Fr. 1821]	477	[567]
= <i>Boletus hirsutus</i> Wulfen:Fr. 1788		
<i>hirta</i> , <i>Hexagonia</i> [(P.Beauv.:Fr.) Fr. 1838, comb. nov.]	496	[-]
= <i>Favolus hirtus</i> P.Beauv.:Fr. 1803		
= <i>Polyporus hirtus</i> (P.Beauv.:Fr.) Fr. 1821		
<i>hirtum</i> , <i>Hydnum</i> [Fr. 1838, sp. nov.]	514	[612]
<i>hispidus</i> , <i>Polyporus</i> [(Bull.:Fr.) Fr. 1818]	458	[551]
= <i>Boletus hispidus</i> Bull.:Fr. 1785		
<i>hollii</i> , <i>Hydnum</i> [(J.C.Schmidt:Fr.) Fr. 1821]	517	[615]
= <i>Sistotrema hollii</i> J.C.Schmidt:Fr. 1817		
<i>hortense</i> , <i>Hydnum septentrionale</i> var. [Fr. 1838, var nov.]	513	[610 sub <i>Hydnum septentrionale</i>]
= <i>Hydnum cirrhatum</i> β <i>concreescens</i> Bong. ex Weinm. 1836, and <i>Hydnum cirrhatum</i> γ <i>tenax</i> Weinm. 1836		
<i>hydnoides</i> , <i>Trametes</i> [(Sw.:Fr.) Fr. 1838, comb. nov.]	490	[-]
= <i>Boletus hydnoides</i> Sw.:Fr. 1788		
= <i>Polyporus hydnoides</i> (Sw.:Fr.) Fr. 1821		
<i>Hydnum</i> [L.:Fr. 1753]	505, 605	[13, 598]
<i>Hymenula</i> [Fr.:Fr. 1825]	593, 608	[16, 700]
<i>Hypochnus</i> [Fr. ex Ehrenb.:Fr. 1820]	569, 607	[15, 659 as <i>Corticium</i> subgen. <i>Hypochnus</i>]
<i>hystrix</i> , <i>Hericium</i> [Pers.:Fr. 1797]	520	[618]
= <i>Hydnum hystrix</i> (Pers.:Fr.) Fr. 1821		
I		
<i>igniarius</i> , <i>Polyporus</i> [(L.:Fr.) Fr. 1821]	466	[559]
= <i>Boletus igniarius</i> L.:Fr. 1753		
<i>imberbis</i> , <i>Polyporus</i> [(Bull.) Fr. 1838, comb. nov.]	451	[543]
= <i>Boletus imberbis</i> Bull. 1790		
<i>imbricatum</i> , <i>Hydnum</i> [L.:Fr. 1753]	505	[598]
<i>imbricatus</i> , <i>Polyporus</i> [(Bull.:Fr.) Fr. 1821]	450	[542]
= <i>Boletus imbricatus</i> Bull.Fr. 1788		
<i>impolitus</i> , <i>Boletus</i> [Fr. 1838, sp. nov.]	421	[509]
<i>impressa</i> , <i>Exidia</i> [(Pers.:Fr.) Fr. 1822]	591	[694]
= <i>Tremella impressa</i> Pers.:Fr. 1822		
<i>inaequalis</i> , <i>Clavaria</i> [O.F.Müll.:Fr. 1780]	577	[674]
<i>incarnata</i> , <i>Clavaria</i> [Weinm. 1836]	580	[678]
<i>incarnata</i> , <i>Typhula</i> [Lasch ex Fr. 1838, sp. nov.]	585	[683]
<i>incarnatum</i> , <i>Corticium</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	564	[654]
= <i>Thelephora incarnata</i> Pers.:Fr. 1801		
<i>incarnatus</i> , <i>Merulius</i> [Schwein.:Fr. 1822]	500	[-]
<i>incarnatus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1818]	484	[573]
= <i>Poria incarnata</i> Pers.:Fr. 1794		
= <i>Boletus incarnatus</i> (Pers.:Fr.) Pers. 1801		
<i>incendiarius</i> , <i>Polyporus</i>		
[(Bong. ex Weinm.) Fr. 1838, comb. nov.]	431	[527]
= <i>Polyporus brumalis</i> β <i>incendiarius</i> Bong. ex Weinm. 1836		

Taxon	Page	[Hym. Eur. page]
<i>incomptus</i> , <i>Polyporus</i> [Fr. 1838, sp. nov., 'incomtus']	437	[-]
= 'Fr. Afz. Fung. Guin. f. 11' [ined.]		
incomtus [sic], <i>Polyporus</i> – See <i>incomptus</i> , <i>Polyporus</i>		
<i>incondita</i> , <i>Trametes</i> [Fr. 1838, sp. nov.]	490	[-]
= 'Fung. Guin. f. 16' [ined.]		
<i>indecorata</i> , <i>Tremella</i> [Sommerf.:Fr. 1826]	589	[692]
<i>inflata</i> , <i>Mitrulella</i> [Schwein. ex Fr.:Fr. 1828]	584	[-]
<i>infundibuliforme</i> , <i>Stereum</i> [(Hook.:Fr.) Fr. 1838, comb. nov.] .	545	[-]
= <i>Thelephora infundibuliformis</i> Hook.:Fr. 1822		
<i>infundibulum</i> , <i>Hydnum</i> [Sw.:Fr. 1810]	506	[600]
<i>intumescens</i> , <i>Tremella</i> [Sm.:Fr. 1808]	589	[691]
<i>intybacea</i> , <i>Thelephora</i> [Pers.:Fr. 1801]	538	[635]
<i>intybaceus</i> , <i>Polyporus</i> [Fr. 1838, sp. nov.]	446	[538]
= <i>Boletus intybaceus</i> auct., pro parte		
<i>involutum</i> , <i>Stereum</i> [Klotzsch ex Fr. 1838, sp. nov.]	546	[-]
<i>Irpex</i> [Fr.:Fr. 1828]	521, 606	[13, 619]
<i>isabellina</i> , <i>Thelephora</i> [(Fr.) Fr. 1838, comb. nov.]	544	[660 as <i>Corticium isabellinum</i>]
= <i>Hypochnus isabellinus</i> Fr. 1818		
<i>isabellinus</i> , <i>Polyporus</i> [(Schwein.:Fr.) Steud. 1824]	457	[-]
= <i>Boletus isabellinus</i> Schwein.:Fr. 1822		

J

<i>japonicus</i> , <i>Polyporus lucidus</i> var. [Fr. 1838, nom. nov.]	442	[-]
= <i>Boletus dimidiatus</i> Thunb. 1784		
<i>juncea</i> , <i>Clavaria</i> [(Alb. & Schwein.:Fr.) Fr. 1818]	579	[677]
= <i>Clavaria triuncialis</i> ß <i>juncea</i> Alb. & Schwein.:Fr. 1805		
<i>juniperinum</i> , <i>Corticium</i> [(Weinm.:Fr.) Fr. 1838, comb. nov.] .	559	[648]
= <i>Thelephora juniperina</i> Weinm.:Fr. 1828		

K

<i>Kneiffia</i> [Fr. 1836]	529, 606	[14, 628]
<i>krombholzii</i> , <i>Clavaria</i> [Fr. 1838, sp. nov.]	572	[669]
= <i>Clavaria kunzei</i> sensu Krombh. [?year], non Fr.:Fr. 1821		
<i>kunzei</i> , <i>Clavaria</i> [Fr.:Fr. 1821]	573	[669]
<i>kymatodes</i> , <i>Polyporus</i> [Rostk. 1830]	457	[550 'kymathodes']

L

<i>labyrinthicus</i> , <i>Polyporus</i> [Fr.:Fr. 1828]	459	[-]
<i>lacera</i> , <i>Cyphella</i> [(Pers.:Fr.) Fr. 1822]	568	[664]
= <i>Peziza lacera</i> Pers.:Fr. 1822		
<i>lacerum</i> , <i>Porothelium</i> [Fr.:Fr. 1818]	503	[595]
<i>laciniata</i> , <i>Thelephora</i> [(Pers.:Fr.) Pers. 1801]	540	[636]
= <i>Stereum laciniatum</i> Pers.:Fr. 1796		
<i>laciniatus</i> , <i>Polyporus</i> [Pers. 1825]	433	[530]
<i>lacrymans</i> , <i>Merulius</i> [(Wulfen:Fr.) Schumach. 1803]	502	[594]
= <i>Boletus lacrymans</i> Wulfen:Fr. 1781		

Taxon	Page	[Hym. Eur. page]
<i>lacteum, Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	560	[649]
= <i>Thelephora lactea</i> Fr.:Fr. 1821		
<i>lacteus, Irpex</i> [(Fr.:Fr.) Fr. 1828]	522	[621]
= <i>Sistotrema lacteum</i> Fr.:Fr. 1818		
= <i>Hydnum lacteum</i> (Fr.:Fr.) Fr. 1821		
<i>lacteus, Polyporus</i> [Fr.:Fr. 1821]	453	[546]
<i>laeta, Cyphella</i> [Fr. 1838, sp. nov.]	568	[664]
<i>laetum, Radulum</i> [Fr.:Fr. 1828]	525	[624]
<i>laeve, Corticium</i> [Pers.:Fr. 1794]	560	[649]
<i>laevigatum, Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	565	[656]
= <i>Thelephora laevigata</i> Fr.:Fr. 1828		
<i>laevigatum, Hydnum</i> [Sw.:Fr. 1810]	506	[599]
<i>laevis, Boletus</i> [Fr. 1835]	425	[516]
<i>laminosa, Sparassis</i> [Fr. 1836]	570	[666]
<i>lanata, Trametes</i> [Fr. 1838, sp. nov.]	490	[-]
= 'Fung. Guin. f. 15' [ined.]		
<i>laneus, [†] Polyporus</i> [Pers. 1825]	488	[-]
<i>languidus, Polyporus</i> [Fr. 1838, sp. nov.]	442	[-]
= 'Fung. Guin. l. c.' [ined.]		
<i>Laschia</i> [Fr.:Fr. 1830]	499, 605	[591]
<i>latissima, Daedalea</i> [(Fr.:Fr.) Fr. 1821]	495	[589]
= <i>Polyporus latissimus</i> Fr.:Fr. 1815		
<i>lauri, Calocera</i> [(Brot.:Fr.) Fr. 1832]	581	[680]
= <i>Clavaria lauri</i> Brot.:Fr. 1805		
<i>laxa, Thelephora</i> [Fr.:Fr. 1828]	543	[659 as <i>Corticium laxum</i>]
<i>laxum, Corticium evolvens</i> var. [(Pers.) Fr. 1838, comb. nov.]	557	[648 sub <i>Corticium amorphum</i>]
= <i>Thelephora laxa</i> Pers. 1822, non Fr.:Fr. 1828		
<i>leoninum, Hydnum</i> [Fr.:Fr. 1821]	513	[610]
<i>leoninus, Polyporus</i> [Klotzsch 1833]	459	[-]
<i>lepideus, Polyporus</i> [Fr.:Fr. 1818]	430	[526]
<i>leprodes, Polyporus</i> [Rostk. 1828]	439	[535 as <i>Polyporus varius</i> * <i>leprodes</i>]
<i>leprosum, Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	551	[-]
= <i>Thelephora leprosa</i> Fr.:Fr. 1828		
<i>leprosus, Polyporus</i> [Fr.:Fr. 1828]	464	[-]
<i>leptocephalus, Polyporus</i> [(Jacq.:Fr.) Fr. 1821]	432	[528]
= <i>Boletus leptocephalus</i> Jacq.:Fr. 1778		
<i>leucomelas, Polyporus</i> [(Pers.:Fr.) Pers. 1825]	429	[524]
= <i>Boletus leucomelas</i> Pers.:Fr. 1801		
= <i>Polyporus subsquamosus</i> γ <i>P. leucomelas</i> (Pers.:Fr.) Fr. 1821		
<i>levissimus, Polyporus</i> [Fr.:Fr. 1828]	470	[-]
<i>lignosus, ? Polyporus</i> [Klotzsch 1833]	471	[-]
<i>ligula, Clavaria</i> [Schaeff.:Fr. 1774]	578	[676]
<i>lilacinum, Stereum purpureum</i> var. [(Batsch) Fr. 1838, comb. nov.]	548	[639]
= <i>Helvella lilacinum</i> Batsch 1786		

Taxon	Page	[Hym. Eur. page]
<i>limbatus</i> , <i>Polyporus</i> [Link ex Fr.:Fr. 1830]	479	[-]
<i>limitatum</i> , <i>Corticium</i> [(Chaillet ex Fr.:Fr.) Fr. 1838, comb. nov.]	565	[656]
= <i>Thelephora limitata</i> Chaillet ex Fr.:Fr. 1828		
<i>linearis</i> , <i>Hymenula</i> [(Pers.:Fr.) Fr. 1832]	594	[702]
= <i>Tremella linearis</i> Pers.:Fr. 1822		
= <i>Hymenella linearis</i> (Pers.:Fr.) Fr. 1822		
<i>lineatus</i> , ? <i>Polyporus</i> [Pers. 1827]	477	[-]
<i>lingua</i> , <i>Midotis</i> [Fr.:Fr. 1828]	556	[-]
<i>lingua</i> , <i>Polyporus</i> [Blume & T.Nees:Fr. 1826]	442	[-]
<i>lirellosa</i> , [†] <i>Daedalea</i> [Pers. 1828]	495	[-]
<i>lividum</i> , <i>Corticium</i> [Pers.:Fr. 1796]	563	[652]
= <i>Thelephora livida</i> (Pers.:Fr.) Fr. 1818		
<i>lividus</i> , <i>Boletus</i> [Bull.:Fr. 1791]	414	[519]
<i>lobata</i> , <i>Auricularia</i> [(Sommerf.:Fr.) Fr. 1838, comb. nov.] . . .	555	[646]
= <i>Exidia lobata</i> Sommerf.:Fr. 1827 ['1826']		
<i>lobatum</i> , <i>Stereum</i> [(Kunze:Fr.) Fr. 1838, comb. nov.]	547	[-]
= <i>Thelephora lobata</i> Kunze:Fr. 1828		
<i>lobatus</i> , <i>Polyporus</i> [(J.F.Gmel.) Fr. 1838, comb. nov.]	448	[540]
nom. illegit., non <i>Polyporus lobatus</i> Schwein. 1832		
= <i>Boletus lobatus</i> J.F.Gmel. 1792		
<i>lonicerae</i> , <i>Polyporus</i> [Weinm.:Fr. 1826]	467	[560]
<i>lucidus</i> , <i>Polyporus</i> [(Curtis:Fr.) Fr. 1821]	442	[537]
= <i>Boletus lucidus</i> Curtis:Fr. 1781		
<i>lundii</i> , <i>Polyporus</i> [Fr.:Fr. 1828]	479	[-]
<i>lupinus</i> , <i>Boletus</i> [Fr. 1838, sp. nov.]	418	[510]
= <i>Boletus rubeolarius</i> sensu Sw. 1810, non Bull. 1791		
<i>luridus</i> , <i>Boletus</i> [Schaeff.:Fr. 1774]	418	[511]
<i>luteobadium</i> , <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	547	[-]
= <i>Thelephora badia</i> Kunze 1828, nom. illegit., non Hook.:Fr. 1822		
= <i>Thelephora luteobadia</i> Fr.:Fr. 1830		
<i>lutescens</i> , <i>Craterellus</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	532	[630]
= <i>Merulius lutescens</i> Pers.:Fr. 1801		
= <i>Cantharellus lutescens</i> (Pers.:Fr.) Fr. 1821		
<i>lutescens</i> , <i>Polyporus</i> [(Pers.) Pers. 1825]	476	[567]
= <i>Boletus lutescens</i> Pers. 1794		
<i>lutescens</i> , <i>Tremella</i> [Pers.:Fr. 1800]	588	[690]
<i>luteus</i> , <i>Boletus</i> [L.:Fr. 1753]	409	[497]
<i>luteus</i> , <i>Polyporus</i> [Blume & T.Nees:Fr. 1826]	445	[-]

M

<i>macrodon</i> , <i>Hydnum</i> [Pers.:Fr. 1801]	518	[615]
<i>macropus</i> , <i>Clavaria</i> [Pers.:Fr. 1797]	573	[669 sub <i>Clavaria subtilis</i>]
<i>macrorrhiza</i> , <i>Clavaria</i> [Sw.:Fr. 1811]	579	[677]
maculaeforme [sic], <i>Corticium</i> – See <i>maculiforme</i> , <i>Corticium</i>		

Taxon	Page	[Hym. Eur. page]
maculiforme, Corticium		
[(Fr.:Fr.) Fr. 1838, comb. nov., 'maculaeforme']	565	[656
= <i>Thelephora maculiformis</i> Fr.:Fr. 1815		'maculaeforme']
marginatus, Polyporus [(Pers.:Fr.) Fr. 1821]	468	[561]
= <i>Boletus marginatus</i> Pers.:Fr. 1794		
marianum, Corticium [(Carus) Fr. 1838, comb. nov.]	560	[-]
= <i>Pyronema marianum</i> Carus 1835		
marianus [sic], Polyporus – See <i>marianus</i> , <i>Polyporus</i>		
marianus ['marianus'], † <i>Polyporus</i> [Pers. 1827]	462	[-]
maximus, Polyporus [(Brot.:Fr.) Fr. 1838, comb. nov.]	432	[529]
= <i>Boletus maximus</i> Brot.:Fr. 1805		
= <i>Daedalea maxima</i> (Brot.:Fr.) Fr. 1821		
medulla-panis, Polyporus [(Jacq.:Fr.) Fr. 1821]	484	[576]
= <i>Boletus medulla-panis</i> Jacq.:Fr. 1778		
melaleucum, Hydnum [Sw. ex Fr.:Fr. 1815]	510	[606]
melanopus, Polyporus [(Pers.:Fr.) Fr. 1821]	439	[534]
= <i>Boletus melanopus</i> Pers.:Fr. 1797, 'menalopus'		
= <i>Boletus infundibuliformis</i> β <i>melanopus</i> (Pers.:Fr.) Pers. 1801, 'menalopus'		
membranaceum, Hydnum [Bull.:Fr. 1791]	515	[613]
membranaceum, Stereum		
[(Bory ex Fr.:Fr.) Fr. 1838, comb. nov.]	547	[-]
= <i>Thelephora membranacea</i> Bory ex Fr.:Fr. 1830		
membranaceus, Polyporus [(Sw.:Fr.) Fr. 1821]	481	[-]
= <i>Boletus membranaceus</i> Sw.:Fr. 1788		
merismoides, Phlebia [(Fr.:Fr.) Fr. 1821]	526	[624]
= <i>Merulius merismoides</i> Fr.:Fr. 1818		
Merulius [Fr.:Fr. 1821]	499, 605	[12, 591]
mesenterica, Auricularia [(Dicks.:Fr.) Pers. 1822]	555	[646]
= <i>Helvella mesenterica</i> Dicks.:Fr. 1785		
= <i>Thelephora mesenterica</i> (Dicks.:Fr.) Pers. 1801		
= <i>Phlebia mesenterica</i> (Dicks.:Fr.) Fr. 1828		
mesenterica, Tremella [Retz.:Fr. 1769]	588	[691]
micans, Pistillaria [(Pers.:Fr.) Fr. 1821]	587	[686]
= <i>Clavaria micans</i> Pers.:Fr. 1797		
micans, Polyporus [(Ehrenb.:Fr.) Fr. 1821]	484	[573]
= <i>Poria micans</i> Ehrenb.:Fr. 1818		
melchii, Polyporus [Fr.:Fr. 1821]	438	[533]
microporus, Polyporus [(Sw.:Fr.) Fr. 1821]	472	[-]
= <i>Boletus microporus</i> Sw.:Fr. 1788		
Midotis [Fr.:Fr. 1828]	556, 607	[-]
minimum, [†] Hydnum [Bolton 1792]	515	[612]
minimus, Polyporus elegans var. [(Fr.:Fr.) Fr. 1838, comb. nov.] .	441	[536]
= <i>Polyporus nummularius</i> γ <i>minimus</i> Fr.:Fr. 1815		
= <i>Polyporus varius</i> γ <i>minimus</i> (Fr.:Fr.) Fr. 1821		
minutum, Hydnum [Schumach.:Fr. 1803]	512	[609]
mitis, Boletus [Krombh. 1836]	411	[499]
nom. illegit., non <i>Boletus mitis</i> Pers. 1825		

Taxon	Page	[Hym. Eur. page]
<i>Mitrula</i> [Fr.:Fr. 1821]	583, 608	[–]
<i>modestus</i> , <i>Polyporus</i> [Kunze:Fr. 1828]	444	[–]
<i>molare</i> , <i>Radulum</i> [Chaillet ex Fr.:Fr. 1828]	525	[623]
<i>mollis</i> , <i>Daedalea</i> [Sommerf.:Fr. 1826]	495	[585 as <i>Trametes mollis</i>]
<i>mollis</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1821]	454	[547]
= <i>Boletus mollis</i> Pers.:Fr. 1796		
<i>mollis</i> , <i>Thelephora</i> [Fr.:Fr. 1821]	544	[660 as <i>Corticium molle</i>]
<i>mollissima</i> , <i>Thelephora</i> [Pers.:Fr. 1801]	540	[636]
<i>molluscus</i> , <i>Merulius</i> [Fr.:Fr. 1821]	501	[592]
<i>molluscus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1821]	486	[578]
= <i>Boletus molluscus</i> Pers.:Fr. 1801		
<i>montagnei</i> , <i>Polyporus</i> [Fr. 1836]	434	[530]
<i>mori</i> , <i>Hexagonia</i> [Pollini:Fr. 1816]	497	[590]
= <i>Polyporus mori</i> (Pollini:Fr.) Fr. 1821		
<i>moriformis</i> , <i>Dacrymyces</i> [(Sm.:Fr.) Fr. 1822]	592	[692 as <i>Tremella moriformis</i>]
= <i>Tremella moriformis</i> Sm.:Fr. 1812		
<i>mougeotii</i> , <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	558	[654]
= <i>Thelephora mougeotii</i> Fr.:Fr. 1828		
<i>mucida</i> , <i>Clavaria</i> [Pers.:Fr. 1797]	580	[679]
<i>mucida</i> , <i>Grandinia</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	527	[626]
= <i>Thelephora mucida</i> Fr.:Fr. 1828		
<i>mucidum</i> , <i>Hydnum</i> [J.F.Gmel.:Fr. 1792]	518	[616]
<i>mucidus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1821]	485	[577]
= <i>Poria mucida</i> Pers.:Fr. 1796		
<i>multipartita</i> , <i>Thelephora</i> [Schwein. ex Fr.:Fr. 1828]	536	[–]
<i>muscolica</i> , <i>Cyphella</i> [Fr.:Fr. 1822]	568	[663]
<i>muscolica</i> , <i>Typhula</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	585	[684]
= <i>Clavaria muscolica</i> Pers.:Fr. 1800		
= <i>Pistillaria muscolica</i> (Pers.:Fr.) Fr. 1821		
<i>muscigena</i> , <i>Cyphella</i> [(Pers.) Fr. 1838, comb. nov.]	567	[663]
= <i>Thelephora muscigena</i> Pers. 1801		
<i>muscoides</i> , <i>Clavaria</i> [L. 1753]	571	[667]
<i>muscorum</i> , <i>Sistotrema</i> [Schwein.:Fr. 1822]	520	[–]
<i>mytilinum</i> , <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	548	[–]
= <i>Thelephora mytilina</i> Fr.:Fr. 1828		

N

<i>Naematelia</i> [Fr.:Fr. 1822]	591, 608	[16, 696]
<i>neckerae</i> , <i>Cyphella</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	568	[663]
= <i>Cyphella muscolica</i> δ <i>neckerae</i> Fr.:Fr. 1822		
<i>neesii</i> , <i>Polyporus</i> [Fr.:Fr. 1821]	472	[564]
<i>nidulans</i> , <i>Polyporus</i> [Fr.:Fr. 1821]	455	[548]
<i>nigra</i> , <i>Hymenula</i> [(Fr.:Fr.) Fr. 1832]	594	[701]
= <i>Hymenella nigra</i> Fr.:Fr. 1822		

Taxon	Page	[Hym. Eur. page]
<i>nigra pannosa</i> [sic], <i>Thelephora</i> – See <i>nigropannosa</i> , <i>Thelephora nigrescens</i> , <i>Corticium</i> [(Schrad.) Fr. 1838, comb. nov.]	565	[656]
= <i>Thelephora nigrescens</i> Schrad. 1794		
<i>nigricans</i> , <i>Agyrium</i> [Fr.:Fr. 1822]	593	[–]
<i>nigricans</i> , <i>Polyporus</i> [Fr.:Fr. 1821]	466	[558]
<i>nigripes</i> , <i>Polyporus</i> [Fr.:Fr. 1830]	435	[–]
<i>nigrita</i> , <i>Clavaria</i> [Pers.:Fr. 1797]	578	[676]
<i>nigrocinctus</i> , <i>Hypochnus</i> [Ehrenb.:Fr. 1820]	569	[–]
<i>nigropannosa</i> , † <i>Thelephora</i> [Secr. ex Fr. 1838, sp. nov., ‘ <i>nigra pannosa</i> ’]	545	[–]
= <i>Thelephora nigra pannosa</i> Secr. 1833, nom. inval.		
<i>nigrum</i> , <i>Hydnum</i> [Fr.:Fr. 1815]	509	[605]
<i>nitens</i> , <i>Polyporus</i> [Fr.:Fr. 1830]	463	[–]
<i>nitidus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1818]	483	[574]
= <i>Poria nitida</i> Pers.:Fr. 1800		
= <i>Boletus nitidus</i> (Pers.:Fr.) Pers. 1801		
<i>niveum</i> , <i>Hydnum</i> [(Pers.:Fr.) Pers. 1801]	518	[616]
= <i>Odontia nivea</i> Pers.:Fr. 1794		
<i>niveus</i> , <i>Merulius</i> [Fr.:Fr. 1828]	501	[592]
<i>nodulosus</i> , <i>Polyporus</i> [Fr. 1838, sp. nov.]	474	[566]
<i>nubilis</i> , <i>Polyporus</i> [Fr. 1838, sp. nov.]	471	[–]
= ‘ <i>Fung. Guin. f. 1</i> ’ [ined.]		
<i>nucleata</i> , <i>Naematelia</i> [(Schwein.:Fr.) Fr. 1822]	592	[696]
= <i>Tremella nucleata</i> Schwein.:Fr. 1822		
<i>nudum</i> , <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	564	[655]
= <i>Thelephora nuda</i> Fr.:Fr. 1821		
<i>nummularius</i> , <i>Polyporus elegans</i> var. [(Bull.) Fr. 1838, comb. nov.]	441	[536]
= <i>Boletus nummularius</i> Bull.:Fr. 1782–83		
= <i>Polyporus varius</i> β <i>nummularius</i> (Bull.) Fr. 1821		
= <i>Polyporus nummularius</i> (Bull.:Fr.) Pers. 1825		
O		
<i>obducens</i> , <i>Polyporus</i> [Pers. 1825]	485	[577]
<i>obliquus</i> , <i>Irpex</i> [(Schrad.:Fr.) Fr. 1828]	523	[622]
= <i>Hydnum obliquum</i> Schrad.:Fr. 1794		
= <i>Sistotrema obliquum</i> (Schrad.:Fr.) Alb. & Schwein. 1805		
<i>obliquus</i> , <i>Polyporus</i> [(Ach. ex Pers.:Fr.) Fr. 1821]	482	[570]
= <i>Boletus obliquus</i> Ach. ex Pers.:Fr. 1801		
<i>obsoletus</i> , <i>Polyporus</i> [Fr.:Fr. 1830]	442	[–]
<i>obsonium</i> , <i>Boletus</i> [(Paulet) Fr. 1838, comb. nov.]	421	[509]
= <i>Tubiporus obsonium</i> Paulet ?1793		
<i>obtusum</i> , [†] <i>Hydnum</i> [Schrad.:Fr. 1794]	525	[623 sub <i>Radulum quercinum</i>]
<i>occarium</i> , <i>Sistotrema</i> [(Batsch:Fr.) Fr. 1838, comb. nov.]	520	[619]
= <i>Hydnum occarium</i> Batsch:Fr. 1783		

Taxon	Page	[Hym. Eur. page]
<i>occidentale, Hydnum</i> [Fr. 1838, nom. nov.]	510	[606]
= <i>Scutigera spinosus</i> Paulet ?1793		
<i>occidentalis, Trametes</i> [(Klotzsch) Fr. 1838, comb. nov.]	491	[-]
= <i>Polyporus occidentalis</i> Klotzsch 1833		
<i>ocellata, Grandinia</i> [Fr. 1838, sp. nov.]	527	[626]
<i>ochraceum, Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	563	[652]
= <i>Thelephora ochracea</i> Fr.:Fr. 1815		
<i>ochraceum, Hydnum</i> [Pers.:Fr. 1792]	514	[612]
<i>ochroideum, Corticium sulphureum</i> var. [Fr. 1838, nom. nov.]	561	[-]
= <i>Himantia ochracea</i> Fr. 1815		
<i>ochroleucum, Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	557	[639 as <i>Stereum ochroleucum</i>]
= <i>Thelephora ochroleuca</i> Fr.:Fr. 1818		
<i>ocreatus, Craterellus</i> [Pers. 1825]	532	[631]
<i>Odontia</i> [Fr. 1835]	528, 606	[14, 627]
<i>odora, Trametes</i> [(Sommerf.:Fr.) Fr. 1838, comb. nov.]	491	[584]
= <i>Polyporus odoratus</i> Sommerf.:Fr. 1826		
<i>odorata, Trametes</i> [(Wulfen:Fr.) Fr. 1838, comb. nov.]	489	[582]
= <i>Boletus odoratus</i> Wulfen:Fr. 1789		
= <i>Polyporus odoratus</i> (Wulfen:Fr.) Fr. 1821		
<i>odoratum, Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	553	[644]
= <i>Thelephora odorata</i> Fr.:Fr. 1815		
<i>odoratus, Craterellus</i> [(Schwein.:Fr.) Fr. 1838, comb. nov.] . .	532	[-]
= <i>Merulius odoratus</i> Schwein.:Fr. 1822		
= <i>Cantharellus odoratus</i> (Schwein.:Fr.) Fr. 1828		
<i>officinalis, Polyporus</i> [(Batsch:Fr.) Fr. 1821]	462	[555]
= <i>Boletus officinalis</i> Batsch:Fr. 1783		
<i>olivacea, Thelephora</i> [(Fr.:Fr.) Pers. 1822]	543	[660 as <i>Corticium olivaceum</i>]
= <i>Hypochnus olivaceus</i> Fr.:Fr. 1818		
<i>olivaceum, Geoglossum</i> [Pers.:Fr. 1796]	582	[-]
<i>olivaceum, Hydnum</i> [(Schwein.:Fr.) Fr. 1828]	514	[-]
= <i>Sistotrema olivaceum</i> Schwein.:Fr. 1822		
<i>olivaceus, Boletus</i> [Schaeff. 1774]	416	[506]
<i>orbiculare, Radulum</i> [Fr.:Fr. 1825]	524	[623]
<i>orbiculata, Hexagonia</i> [Fr. 1838, sp. nov.]	497	[-]
= 'Fung. Guin. f. 9' [ined.]		
<i>orbiculatum, Hydnum</i> [Pers.:Fr. 1801]	513	[611]
<i>orbiformis, Polyporus</i> [Fr. 1838, sp. nov.]	463	[-]
= 'Fung. Guin. l. c.' [ined.]		
<i>orientale, Hydnum</i> [Fr.:Fr. 1821]	510	[-]
<i>ostrea, Stereum</i> [(Blume & T.Nees:Fr.) Fr. 1838, comb. nov.] . .	547	[-]
= <i>Thelephora ostrea</i> Blume & T.Nees:Fr. 1826		
<i>ovata, Pistillaria</i> [(Pers.:Fr.) Fr. 1821]	587	[687]
= <i>Clavaria ovata</i> Pers.:Fr. 1797		
<i>ovinus, Polyporus</i> [(Schaeff.:Fr.) Fr. 1821]	428	[523]
= <i>Boletus ovinus</i> Schaeff.:Fr. 1774		

Taxon	Page	[Hym. Eur. page]
P		
pachydon [sic], Sistotrema – See <i>pachyodon</i> , <i>Sistotrema</i>		
<i>pachyodon</i>, <i>Sistotrema</i>		
[(Pers.:Fr.) Fr. 1838, comb. nov., ‘pachydon’]	520	[619]
= <i>Hydnum pachyodon</i> Pers.:Fr. 1825		
<i>pachypus</i> , <i>Boletus</i> [Fr.:Fr. 1815]	417	[506]
<i>paleaceus</i> , <i>Irpex</i> [(Thore:Fr.) Fr. 1828]	522	[620]
= <i>Hydnum paleaceum</i> Thore:Fr. 1803		
= <i>Sistotrema paleaceum</i> (Thore:Fr.) Pers. 1825		
<i>paleaceus</i>, <i>Polyporus</i> [Fr. 1838, sp. nov.]	471	[–]
= ‘Fung. Guin. f. 18’ [ined.]		
<i>pal lens</i> , <i>Agyrium rufum</i> var. [Fr.:Fr. 1822]	593	[–]
<i>palles cens</i>, <i>Irpex</i> [Fr. 1838, sp. nov.]	522	[–]
= <i>Irpex paleaceus</i> sensu Schwein. 1832, ‘An nova species’, non (Thore:Fr.) Fr. 1828		
<i>pallescens</i> , <i>Polyporus</i> [Fr.:Fr. 1818]	462	[546]
<i>palmata</i>, <i>Calocera</i> [(Schumach.) Fr. 1838, comb. nov.]	581	[680]
= <i>Tremella palmata</i> Schumach. 1803		
<i>palmata</i> , <i>Thelephora</i> [(Scop.:Fr.) Fr. 1821]	537	[634]
= <i>Clavaria palmata</i> Scop.:Fr. 1772		
<i>palmatum</i> , <i>Hydnum</i> [Hook.:Fr. 1822]	511	[–]
<i>paludosa</i> , <i>Mitrlula</i> [Fr.:Fr. 1816]	584	[–]
<i>pandani</i> , <i>Polyporus</i> [Fr.:Fr. 1821]	469	[–]
<i>pannosa</i> , <i>Thelephora</i> [(Sowerby:Fr.) Fr. 1821]	535	[633 sub <i>Thelephora</i> sowerbeji]
= <i>Helvella pannosa</i> Sowerby:Fr. 1798–99		
<i>papillosa</i>, <i>Grandinia</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	528	[626]
= <i>Thelephora papillosa</i> Fr.:Fr. 1828		
<i>papyraceum</i> , <i>Hydnum</i> [Wulfen:Fr. 1787]	515	[612]
<i>papyraceus</i> , <i>Merulius</i> [Fr.:Fr. 1828]	503	[594]
<i>papyraceus</i> , <i>Polyporus</i> [Fr.:Fr. 1828]	481	[–]
<i>paradoxus</i>, <i>Irpex</i> [(Schrad.:Fr.) Fr. 1838, comb. nov.]	522	[621]
= <i>Hydnum paradoxum</i> Schrad.:Fr. 1794		
<i>parasitica</i> , <i>Tremella</i> [Schwein.:Fr. 1822]	590	[–]
<i>parasiticus</i> , <i>Boletus</i> [Bull.:Fr. 1790]	412	[505]
<i>pargamensis</i> [sic], <i>Polyporus</i> – See <i>pergamensis</i> , <i>Polyporus</i>		
<i>parvulus</i> , <i>Polyporus</i> [Klotzsch 1833]	435	[–]
nom. illegit., non <i>Polyporus parvulus</i> Schwein. 1832		
<i>pauletii</i>, <i>Polyporus</i> [Fr. 1838, nom. nov.]	449	[541]
= <i>Scutigera badius</i> Paulet ?1793		
<i>pavonia</i>, <i>Cora</i> [(F.Weber & D.Mohr) Fr. 1838, comb. nov.]	556	[–]
= <i>Thelephora pavonia</i> F.Weber & D.Mohr 1805		
<i>pavonius</i>, <i>Polyporus</i> [(Hook.) Fr. 1838, comb. nov.]	477	[–]
= <i>Boletus pavonius</i> Hook. 1822		
<i>pectinatum</i> , <i>Hydnum</i> [Fr.:Fr. 1821]	514	[611]
<i>pectinatus</i> , <i>Polyporus</i> [Klotzsch 1833]	467	[559]
<i>pedicellata</i> , <i>Thelephora</i> [Schwein.:Fr. 1822]	544	[–]

Taxon	Page	[Hym. Eur. page]
<i>pediformis</i> , <i>Polyporus</i> [Fr. 1838, sp. nov.]	463	[-]
= 'Fung. Guin. f. 2' [ined.]		
<i>pendula</i> , <i>Cyphella</i> [(Schwein.:Fr.) Fr. 1822]	567	[-]
= <i>Peziza pendula</i> Schwein.:Fr. 1822		
= <i>Peziza digitalis</i> sensu Schwein. 1822, non Alb. & Schwein.:Fr. 1805		
<i>pendulum</i> , <i>Radulum</i> [Fr.:Fr. 1828]	524	[623]
<i>pendulus</i> , <i>Irpex</i> [(Alb. & Schwein.:Fr.) Fr. 1828]	521	[620]
= <i>Sistotrema pendulum</i> Alb. & Schwein.:Fr. 1805		
= <i>Hydnum pendulum</i> (Alb. & Schwein.:Fr.) Fr. 1821		
<i>perennis</i> , <i>Polyporus</i> [(L.:Fr.) Fr. 1821]	434	[531]
= <i>Boletus perennis</i> L.:Fr. 1753		
<i>pergamenus</i> , <i>Polyporus</i> [Fr. 1838, sp. nov., 'pargamenus'] . . .	480	[-]
<i>peronata</i> , <i>Typhula</i> [(Pers.) Fr. 1838, comb. nov.]	585	[685]
= <i>Clavaria peronata</i> Pers. 1822		
<i>perula</i> , † <i>Polyporus</i> [(P.Beauv.:Fr.) Fr. 1821]	437	[-]
= <i>Microporus perula</i> P.Beauv.: Fr. 1805		
<i>pes-caprae</i> , <i>Polyporus</i> [Pers.:Fr. 1818]	447	[524]
<i>petalodes</i> [sic], <i>Polyporus</i> – See <i>petaloides</i> , <i>Polyporus</i>		
<i>petaloides</i> , <i>Polyporus</i> [Fr. 1838, sp. nov., 'petalodes']	444	[536]
<i>petropolitanus</i> , <i>Merulius</i> [Fr. ex Weinm. 1836]	500	[591]
<i>phacorrhiza</i> , <i>Typhula</i> [(Reichard:Fr.) Fr. 1821]	585	[683]
= <i>Clavaria phacorrhiza</i> Reichard:Fr. 1780		
<i>Phlebia</i> [Fr.:Fr. 1821]	526, 606	[13, 624]
<i>picipes</i> , <i>Polyporus</i> [Fr. 1838, sp. nov.]	440	[534]
= <i>Polyporus varius</i> sensu Grev. 1825, non (Pers.:Fr.) Fr. 1821		
<i>pictus</i> , <i>Polyporus</i> [(Schultz) Fr. 1838, comb. nov.]	435	[531]
= <i>Boletus pictus</i> Schultz 1806		
<i>pinastri</i> , <i>Hydnum</i> [(Fr.:Fr.) Fr. 1815]	517	[614]
= <i>Sistotrema pinastri</i> Fr.:Fr. 1814		
<i>pini</i> , <i>Stereum</i> [(Schleich. ex Fr.:Fr.) Fr. 1838, comb. nov.] . . .	553	[643]
= <i>Thelephora pini</i> Schleich. ex Fr.:Fr. 1815		
<i>pini</i> , <i>Trametes</i> [(Brot.:Fr.) Fr. 1838, comb. nov.]	489	[582]
= <i>Boletus pini</i> Brot.:Fr. 1805		
= <i>Daedalea pini</i> (Brot.:Fr.) Fr. 1821		
<i>pinicola</i> , <i>Polyporus</i> [(Sw.:Fr.) Fr. 1821]	468	[561]
= <i>Boletus pinicola</i> Sw.:Fr. 1810		
<i>pinnatifida</i> , <i>Tremella</i> [Spreng. ex Fr.:Fr. 1822]	589	[-]
<i>pinsitus</i> , <i>Polyporus</i> [Fr.:Fr. 1828]	479	[-]
<i>piperatus</i> , <i>Boletus</i> [Bull.:Fr. 1790]	412	[500]
<i>Pistillaria</i> [Fr.:Fr. 1821]	586, 608	[15, 686]
<i>pistillaris</i> , <i>Clavaria</i> [L.:Fr. 1753]	578	[676]
<i>pistillaris</i> , <i>Craterellus</i> [Fr. 1838, sp. nov.]	534	[632]
<i>pithya</i> [sic], <i>Exidia</i> – See <i>pitya</i> , <i>Exidia</i>		
<i>pitya</i> ['pithya'], <i>Exidia</i> [(Alb. & Schwein.:Fr.) Fr. 1821]	591	[694 'pithya']
= <i>Tremella auricula-judae</i> γγ <i>pitya</i> Alb. & Schwein.:Fr. 1805		
<i>politum</i> , <i>Hydnum</i> [Fr. 1836]	507	[601]

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<i>politus</i> , <i>Polyporus</i> [Fr. 1836]	429	[525]
<i>polycocca</i> , <i>Grandinia</i> [(Mont.) Fr. 1838, comb. nov.]	527	[-]
= <i>Thelephora polycocca</i> Mont. 1837		
<i>polygonium</i> , <i>Corticium</i> [Pers.:Fr. 1794]	564	[655]
= <i>Thelephora polygonia</i> (Pers.:Fr.) Pers. 1801		
<i>polygramma</i> , <i>Hexagonia</i> [(Mont.) Fr. 1838, comb. nov.]	497	[-]
= <i>Polyporus polygrammus</i> Mont. 1837		
<i>Polyporus</i> [Fr.:Fr. 1815]	427, 603	[11, 522]
<i>polyzonus</i> , <i>Polyporus</i> [Pers. 1827]	477	[-]
<i>populinum</i> , <i>Corticium</i> [(Sommerf.) Fr. 1838, comb. nov.]	559	[648]
= <i>Thelephora populina</i> Sommerf. 1826		
<i>populinus</i> , <i>Polyporus</i> [(Schumach.:Fr.) Fr. 1821]	472	[564]
= <i>Boletus populinus</i> Schumach.:Fr. 1803		
<i>porinoides</i> , <i>Merulius</i> [Fr.:Fr. 1818]	501	[593]
<i>Porothelium</i> [' <i>Porothelium</i> '] [Fr.:Fr. 1818]	503, 605	[13, 595 ' <i>Porothelium</i> ']
<i>Porothelium</i> [sic] – See <i>Porothelium</i>		
<i>porphyrosporus</i> , <i>Boletus</i> [Fr. 1835]	423	[514]
<i>porrectum</i> , <i>Stereum</i> [Fr. 1838, nom. nov.]	548	[-]
= <i>Thelephora grisea</i> Schwein.:Fr. 1822		
<i>portoricensis</i> , <i>Polyporus</i> [Spreng. ex Fr.:Fr. 1828]	482	[-]
<i>proliferum</i> , <i>Hydnum</i> [Fr. 1838, sp. nov.]	509	[-]
= ' <i>Fung. Guin. f. 28</i> ' [ined.]		
nom. illegit., non <i>Hydnum proliferum</i> Pers. 1825		
<i>prolificans</i> , <i>Polyporus</i> [Fr. 1838, sp. nov.]	443	[-]
<i>pruinatus</i> , <i>Boletus</i> [Fr. 1835]	414	[504]
<i>pruinatus</i> , <i>Polyporus</i> [Klotzsch 1833]	473	[-]
<i>pterygodes</i> , <i>Polyporus</i> [Fr. 1838, sp. nov.]	445	[-]
= ' <i>Fung. Guin. f. 7</i> ' [ined.]		
<i>puberum</i> , <i>Corticium calceum</i> var.		
[(Fr.:Fr.) Fr. 1838, comb. nov.]	562	[652 as <i>Corticium</i>
= <i>Thelephora pubera</i> Fr.:Fr. 1828		<i>puberum</i>]
<i>pubescens</i> , <i>Polyporus</i> [(Schumach.:Fr.) Fr. 1815]	462	[553]
= <i>Boletus pubescens</i> Schumach.:Fr. 1803		
<i>pudorinum</i> , <i>Hydnum</i> [Fr.:Fr. 1828]	514	[612]
<i>pulcher</i> , <i>Polyporus</i> [Fr.:Fr. 1830]	437	[-]
<i>pulverulentus</i> , <i>Merulius</i> [(Sowerby:Fr.) Fr. 1828]	502	[594 as <i>Merulius</i>
= <i>Auricularia pulverulenta</i> Sowerby:Fr. 1798–99		<i>lacrymans</i> * <i>pulverulentus</i>]
<i>punicea</i> , <i>Thelephora</i> [Alb. & Schwein.:Fr. 1805]	541	[661 as <i>Corticium</i>
		<i>puniceum</i>]
<i>purpurascens</i> , <i>Polyporus</i> [Fr. 1838, nom. nov.]	473	[-]
nom. illegit., non <i>Polyporus purpurascens</i> Pers. 1825		
[= <i>Boletus purpurascens</i> DC. 1815, nom. illegit.]		
= <i>Boletus purpurascens</i> Hook. 1822, nom. illegit., non Pers. 1796, nec DC. 1815		
<i>purpurea</i> , <i>Clavaria</i> [O.F.Müll.:Fr. 1780]	576	[674]
<i>purpureum</i> , <i>Stereum</i> [Pers.:Fr. 1794]	548	[639]
= <i>Thelephora purpurea</i> (Pers.:Fr.) Pers. 1801		

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<i>purpureus</i> , <i>Boletus</i> [Fr. 1835]	419	[511]
<i>purpureus</i> , <i>Polyporus</i> [Fr.:Fr. 1821]	484	[572]
<i>pusilla</i> , <i>Pistillaria</i> [(Pers.:Fr.) Fr. 1821]	587	[688]
= <i>Clavaria pusilla</i> Pers.:Fr. 1797		
<i>pusillum</i> , <i>Hydnum</i> [Brot.:Fr. 1805]	510	[606]
<i>pusillus</i> , <i>Craterellus</i> [(Fr.:Fr.) Pers. 1825]	533	[632]
= <i>Merulius pusillus</i> Fr.:Fr. 1818		
= <i>Cantharellus pusillus</i> (Fr.:Fr.) Fr. 1821		
<i>pusillus</i> , <i>Favolus</i> [Fr.:Fr. 1830]	499	[–]
<i>puteana</i> [' <i>puteanea</i> '], <i>Thelephora</i> [Schumach.:Fr. 1803]	542	[657 as <i>Corticium puteaneum</i> (sic)]
<i>puteanea</i> [sic], <i>Thelephora</i> – See <i>puteana</i> , <i>Thelephora</i>		
<i>pyxidata</i> , <i>Clavaria</i> [Pers.:Fr. 1794]	573	[669]
Q		
<i>quercina</i> , <i>Daedalea</i> [(L.:Fr.) Pers. 1801]	492	[586]
= <i>Agaricus quercinus</i> L.:Fr. 1753		
<i>quercinum</i> , <i>Corticium</i> [(Pers.:Fr.) Gray 1821]	563	[653]
= <i>Thelephora quercina</i> Pers.:Fr. 1801		
<i>quercinum</i> , <i>Radulum</i> [(Pers.:Fr.) Fr. 1838, comb. nov.]	525	[623]
= <i>Odontia quercina</i> Pers.:Fr. 1800		
= <i>Sistotrema quercinum</i> (Pers.:Fr.) Pers. 1801		
= <i>Hydnum quercinum</i> (Pers.:Fr.) Fr. 1821		
<i>quercinus</i> , <i>Polyporus</i> [(Schrad.) Fr. 1838, comb. nov.]	441	[555]
= <i>Boletus quercinus</i> Schrad. 1794		
<i>quisquiliaris</i> , <i>Pistillaria</i> [(Fr.:Fr.) Fr. 1821]	587	[687]
= <i>Clavaria quisquiliaris</i> Fr.:Fr. 1818		
R		
<i>radiata</i> , <i>Phlebia</i> [Fr.:Fr. 1821]	526	[625]
<i>radiata</i> , <i>Thelephora</i> [Fr. 1838, sp. nov.]	535	[633]
<i>radiatus</i> , <i>Polyporus</i> [(Sowerby:Fr.) Fr. 1821]	474	[565]
= <i>Boletus radiatus</i> Sowerby:Fr. 1798–99		
<i>radicans</i> , <i>Boletus</i> [Pers.:Fr. 1801]	415	[503]
<i>radicata</i> , <i>Fistulina</i> [(Schwein.:Fr.) Fr. 1828]	504	[–]
= <i>Boletus radicans</i> Schwein.:Fr. 1822		
<i>radiosum</i> , <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	560	[649]
= <i>Thelephora radiosa</i> Fr.:Fr. 1818		
<i>radula</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1821]	486	[578]
= <i>Poria radula</i> Pers.:Fr. 1800		
= <i>Boletus radula</i> (Pers.:Fr.) Pers. 1801		
<i>Radulum</i> [Fr.:Fr. 1825]	524, 606	[13, 622]
<i>ramaria</i> , <i>Hydnum</i> [Fr.:Fr. 1821]	512	[608]
<i>ramentacea</i> , <i>Typhula</i> [Fr.:Fr. 1821]	586	[685]
<i>ramosum</i> , <i>Hydnum</i> [Schwein. 1822]	511	[–]
nom. illegit., non <i>Hydnum ramosum</i> Bull. 1789		

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<i>ravidus</i> , <i>Polyporus</i> [Fr. 1838, sp. nov.]	475	[566]
= <i>Boletus heteroclitus</i> sensu Sowerby 1800–03, non Bolton:Fr. 1792		
<i>rawakense</i> , <i>Hydnum</i> [Pers. 1827]	515	[–]
<i>recisa</i> , <i>Exidia</i> [(Ditmar:Fr.) Fr. 1822]	590	[693]
= <i>Tremella recisa</i> Ditmar:Fr. 1813		
<i>regius</i> , <i>Boletus</i> [Krombh. 1832]	420	[508]
<i>regularis</i> , <i>Thelephora</i> [Schwein.:Fr. 1822]	535	[–]
<i>reniforme</i> , <i>Stereum</i> [Fr. 1838, sp. nov., ‘reniforme’]	546	[–]
reniforme [sic], <i>Stereum</i> – See <i>reniforme</i> , <i>Stereum</i>		
<i>repanda</i> , <i>Exidia</i> [Fr.:Fr. 1822]	591	[694]
<i>repandum</i> , <i>Hydnum</i> [L.:Fr. 1753]	506	[601]
<i>repandum</i> , <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	552	[642]
= <i>Thelephora repanda</i> Fr.:Fr. 1828		
<i>resinosus</i> , <i>Polyporus</i> [(Schr.:Fr.) Fr. 1821]	461	[554]
= <i>Boletus resinosus</i> Schrad.:Fr. 1794		
<i>reticulata</i> , <i>Auricularia</i> [Fr. 1838, sp. nov.]	555	[–]
<i>reticulata</i> , <i>Thelephora</i> [Fr.:Fr. 1828]	542	[658 as <i>Corticium reticulatum</i>]
<i>reticulatus</i> , <i>Polyporus</i> [(Nees:Fr.) Fr. 1821]	488	[580]
= <i>Boletus reticulatus</i> Nees:Fr. 1816–17		
<i>rheades</i> , <i>Polyporus</i> [Pers. 1825]	458	[551]
<i>rhodellus</i> , <i>Polyporus</i> [Fr.:Fr. 1818]	484	[573]
<i>rhois</i> , <i>Hydnum</i> [Schwein.:Fr. 1822]	514	[–]
<i>ribis</i> , <i>Polyporus</i> [(Schumach.:Fr.) Fr. 1821]	467	[560]
= <i>Boletus ribis</i> Schumach.:Fr. 1803		
<i>roburneus</i> , <i>Polyporus</i> [Fr. 1838, sp. nov.]	464	[557]
= <i>Polyporus annosus</i> sensu Fr. 1828, non Fr.:Fr. 1821		
<i>rosea</i> , <i>Clavaria</i> [Dalman:Fr. 1811]	577	[674]
<i>rosella</i> , <i>Pistillaria</i> [Fr. 1838, sp. nov.]	587	[688]
<i>roseocarnea</i> , † <i>Thelephora</i> [Schwein. 1822]	544	[–]
<i>roseocinctus</i> , <i>Hypochnus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	569	[–]
= <i>Thelephora roseocincta</i> Fr.:Fr. 1830		
<i>roseum</i> , <i>Corticium</i> [Pers.:Fr. 1794]	560	[650]
= <i>Thelephora rosea</i> (Pers.:Fr.) Pers. 1801		
= <i>Himantia rosea</i> (Pers.:Fr.) Pers. 1815		
<i>roseus</i> , <i>Craterellus</i> [(Schwein.:Fr.) Fr. 1838, comb. nov.]	533	[–]
= <i>Merulius roseus</i> Schwein.:Fr. 1822		
= <i>Cantharellus roseus</i> (Schwein.:Fr.) Fr. 1828		
<i>roseus</i> , <i>Dacrymyces</i> [Fr.:Fr. 1828]	593	[698]
<i>roseus</i> , <i>Polyporus</i> [(Alb. & Schwein.:Fr.) Fr. 1818]	469	[562]
= <i>Boletus roseus</i> Alb. & Schwein.:Fr. 1805		
<i>rostkowi</i> , <i>Polyporus</i> [Fr. 1838, nom. nov.]	439	[534]
= <i>Polyporus infundibuliformus</i> Rostk. 1830, nom. illegit., non Chevall. 1826		
<i>rubella</i> , <i>Hymenula</i> [Fr.:Fr. 1828]	594	[702]
<i>rubellus</i> , <i>Boletus</i> [Krombh. 1836]	426	[518]

Taxon	Page	[Hym. Eur. page]
<i>rubescens</i>, <i>Trametes</i>		
[(Alb. & Schwein.:Fr.) Fr. 1838, comb. nov.]	492	[584]
= <i>Daedalea rubescens</i> Alb. & Schwein.:Fr. 1805		
<i>rubiformis</i>, <i>Naematelia</i> [Fr.:Fr. 1818]	592	[696]
<i>rubiginosum</i>, <i>Stereum</i> [(Dicks.:Fr.) Fr. 1815]	550	[641]
= <i>Helvella rubiginosa</i> Dicks.:Fr. 1785		
= <i>Thelephora rubiginosa</i> (Dicks.:Fr.) Schrad. 1792		
= <i>Stereum rubiginosum</i> (Dicks.:Fr.) Gray 1821, comb. superfl.		
<i>rubiginosus</i>, <i>Boletus</i> [Retz. 1769]	416	[521]
<i>rubiginosus</i>, <i>Polyporus</i> [Fr. 1838, nom. nov.]	460	[-]
nom. illegit., non <i>Polyporus rubiginosus</i> Wallr. 1830		
= <i>Boletus rubiginosus</i> Schrad. 1794, nom. illegit., non Retz. 1769		
<i>rubrocinctus</i>, <i>Hypochinus</i> [Ehrenb.:Fr. 1820]	569	[-]
<i>rudis</i>, <i>Thelephora</i> [Fr.:Fr. 1830]	539	[-]
<i>rufa</i>, <i>Clavaria</i> [(O.F.Müll.:Fr.) Pers. 1797]	576	[674]
= <i>Clavaria polymorpha</i> var. <i>rufa</i> O.F.Müll.:Fr. 1777		
= <i>Clavaria inaequalis</i> ζ <i>rufa</i> (O.F.Müll.:Fr.) Fr. 1828		
<i>rufescens</i>, <i>Clavaria aurea</i> var.		
[(Schaeff.) Fr. 1838, comb. nov.]	574	[670 as <i>Clavaria</i>
= <i>Clavaria rufescens</i> Schaeff. 1774		<i>rufescens</i>]
<i>rufescens</i>, <i>Daedalea unicolor</i> var. [Fr. 1838, var. nov.]	494	[588 sub <i>Daedalea</i>
= <i>Boletus unicolor</i> sensu Bull. 1791, t.501 f.3, non Bull.:Fr. 1789		<i>unicolor</i>]
<i>rufescens</i>, <i>Hydnum</i> [Pers.:Fr. 1800]	506	[601 as <i>Hydnum</i>
= <i>Hydnum repandum</i> * <i>rufescens</i> (Pers.:Fr.) Pers. 1825		<i>repandum</i> * <i>rufescens</i>]
<i>rufescens</i>, <i>Polyporus</i> [(Pers.:Fr.) Fr. 1821]	433	[529]
= <i>Sistotrema rufescens</i> Pers.:Fr. 1801		
<i>rufofulvum</i>, <i>Corticium</i> [(Mont.) Fr. 1838, comb. nov.]	558	[-]
= <i>Thelephora rufofulva</i> Mont. 1837		
<i>rufopallidus</i>, <i>Polyporus</i> [Trog 1832]	469	[561]
<i>rufum</i>, <i>Agyrium</i> [(Pers.:Fr.) Fr. 1822]	593	[-]
= <i>Stictis rufa</i> Pers.:Fr. 1800		
= <i>Tremella stictis</i> Pers. 1801		
<i>rufum</i>, <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	553	[644]
= <i>Thelephora rufa</i> Fr.:Fr. 1828		
<i>rufus</i>, <i>Merulius</i> [Pers.:Fr. 1801]	502	[593]
<i>rufus</i>, <i>Polyporus</i> [(Schrad.:Fr.) Fr. 1821]	484	[573]
= <i>Boletus rufus</i> Schrad.:Fr. 1792		
<i>rugosa</i>, <i>Clavaria</i> [Bull.:Fr. 1790]	572	[669]
<i>rugosum</i>, <i>Stereum</i> [Pers.:Fr. 1794]	552	[643]
= <i>Thelephora rugosa</i> (Pers.:Fr.) Pers. 1801		
<i>rugosus</i>, <i>Boletus</i> [Fr. 1835]	425	[516]
nom. illegit., non <i>Boletus rugosus</i> Jacq. 1774, nec Sowerby 1809–15		
= <i>Boletus fuscoalbus</i> Sowerby 1809–15		
= <i>Boletus leucophaeus</i> Pers. 1825		
<i>rugosus</i>, <i>Polyporus</i> [Blume & T.Nees:Fr. 1826]	435	[-]
<i>rutilans</i>, <i>Polyporus</i> [(Pers.:Fr.) Fr. 1818]	455	[548]
= <i>Boletus rutilans</i> Pers.:Fr. 1798		

Taxon	Page	[Hym. Eur. page]
<i>rutilus</i> , <i>Boletus</i> [Fr. 1835]	412	[500]

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<i>sacchari</i> , <i>Hydnum</i> [Spreng.:Fr. 1820]	516	[-]
<i>saccharina</i> , <i>Exidia</i> [(Alb. & Schwein.:Fr.) Fr. 1821]	591	[694]
= <i>Tremella spiculosa</i> γγ <i>saccharina</i> Alb. & Schwein.:Fr. 1805		
<i>sacer</i> , <i>Polyporus</i> [Afzel. ex Fr. 1838, sp. nov.]	436	[-]
= 'Fr. Fung. Guin. f. 20' [ined.]		
= <i>Boletus sacer</i> Afzel. [ined.]		
<i>salicinum</i> , <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	558	[647]
= <i>Thelephora salicina</i> Fr.:Fr. 1821		
<i>salicinus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1821]	467	[560]
= <i>Boletus salicinus</i> Pers. 1792		
<i>salignus</i> , <i>Polyporus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	452	[544]
= <i>Daedalea saligna</i> Fr.:Fr. 1818		
<i>sambuci</i> , <i>Corticium</i> [Pers. 1794]	565	[660]
<i>sanguinari</i> , <i>Polyporus</i> [Klotzsch 1833]	470	[-]
<i>sanguinea</i> , <i>Daedalea</i> [Klotzsch 1833]	493	[-]
<i>sanguineum</i> , <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	561	[650]
= <i>Thelephora sanguinea</i> Fr.:Fr. 1828		
<i>sanguineus</i> , <i>Boletus</i> [With. 1792]	412	[500]
nom. illegit, non <i>Boletus sanguineus</i> L.:Fr. 1763		
<i>sanguineus</i> , <i>Polyporus</i> [(L.:Fr.) Fr. 1821]	444	[-]
= <i>Boletus sanguineus</i> L.:Fr. 1763		
<i>sanguinolentum</i> , <i>Stereum</i>		
[(Alb. & Schwein.:Fr.) Fr. 1838, comb. nov.]	549	[640]
= <i>Thelephora sanguinolentus</i> Alb. & Schwein.:Fr. 1805		
<i>sanguinolentus</i> , <i>Polyporus</i> [(Alb. & Schwein.:Fr.) Fr. 1815]	486	[578]
= <i>Boletus sanguinolentus</i> Alb. & Schwein.:Fr. 1805		
<i>sarcoides</i> , <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	558	[647]
= <i>Thelephora sarcoides</i> Fr.:Fr. 1828		
<i>sarcoides</i> , <i>Tremella</i> [(Jacq.:Fr.) With. 1796]	589	[-]
= <i>Lichen sarcoides</i> Jacq.:Fr. 1781		
= <i>Helvella sarcoides</i> (Jacq.:Fr.) Dicks. 1785		
= <i>Octospora sarcoides</i> (Jacq.:Fr.) Gray 1821		
= <i>Peziza sarcoides</i> (Jacq.:Fr.) Pers. 1822		
= <i>Bulgaria sarcoides</i> (Jacq.:Fr.) Fr. 1822		
<i>satanas</i> , <i>Boletus</i> [Lenz 1831]	417	[510]
<i>scaber</i> , <i>Boletus</i> [Bull.:Fr. 1783]	424	[515]
<i>scabrosum</i> , <i>Hydnum</i> [Fr. 1836]	505	[599]
<i>scabrosus</i> , <i>Polyporus</i> [Pers. 1827]	469	[-]
<i>schweinitzii</i> ['schweinitzii'], <i>Polyporus</i> [Fr.:Fr. 1821]	433	[529 'schweinitzii']
<i>schweinitzii</i> [sic], <i>Polyporus</i> – See <i>schweinitzii</i> , <i>Polyporus</i>		
<i>sclerotoides</i> , <i>Pistillaria</i> [(DC.:Fr.) Fr. 1821]	586	[686]
= <i>Clavaria sclerotoides</i> DC.:Fr. 1815		

Taxon	Page	[Hym. Eur. page]
<i>sclerotoides</i>, <i>Typhula</i> [(Pers.) Fr. 1838, comb. nov.]	585	[682]
= <i>Phacorrhiza sclerotoides</i> Pers. 1822		
<i>scrobiculatum</i>, <i>Hydnum</i> [Fr. 1815]	509	[604]
<i>scruposus</i>, <i>Polyporus</i> [Fr. 1838, sp. nov.]	473	[-]
<i>scutigera</i>, <i>Hexagonia</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	497	[-]
= <i>Polyporus scutigera</i> Fr.:Fr. 1828		
<i>sebacea</i>, <i>Thelephora</i> [Pers. 1801]	542	[637]
<i>sebaceus</i>, <i>Polyporus</i> [Fr. 1838, sp. nov.]	488	[580 sub <i>Polyporus</i> <i>reticulatus</i>]
= <i>Poria reticulata-sebacea</i> Secr. 1833, nom. inval.		
<i>sector</i>, <i>Polyporus</i> [(Ehrenb.:Fr.) Fr. 1821]	480	[-]
= <i>Boletus sector</i> Ehrenb.:Fr. 1820		
<i>septentrionale</i>, <i>Hydnum</i> [Fr.:Fr. 1821]	513	[610]
<i>seriale</i>, <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	563	[653]
= <i>Thelephora serialis</i> Fr.:Fr. 1821		
<i>serialis</i>, <i>Polyporus</i> [Fr.:Fr. 1821]	476	[585 as <i>Trametes</i> <i>serialis</i>]
<i>sericea</i>, <i>Hexagonia</i> [Fr. 1838, nom. nov.]	497	[-]
= <i>Polyporus sericeohirsutus</i> Klotzsch 1833		
<i>serpens</i>, <i>Daedalea</i> [(Fr.:Fr.) Fr. 1821]	495	[586 as <i>Trametes</i> <i>serpens</i>]
= <i>Polyporus serpens</i> Fr.:Fr. 1818		
<i>serpens</i>, <i>Merulius</i> [Tode:Fr. 1783]	502	[593]
= <i>Xylomyzon serpens</i> (Tode:Fr.) Pers. 1825		
<i>setigera</i>, <i>Kneiffia</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	529	[628]
= <i>Thelephora setigera</i> Fr.:Fr. 1828		
<i>sinensis</i>, <i>Trametes</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	489	[-]
= <i>Polyporus sinensis</i> Fr.:Fr. 1821		
<i>sinulosa</i>, <i>Daedalea</i> [Klotzsch ex Fr. 1838, sp. nov.]	495	[-]
= <i>Daedalea latissima</i> sensu Klotzsch 1833, non (Fr.:Fr.) Fr. 1821		
<i>sinuosus</i>, <i>Craterellus</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	533	[631]
= <i>Cantharellus sinuosus</i> Fr.:Fr. 1821		
<i>sinuosus</i>, <i>Irpex</i> [Fr.:Fr. 1828]	522	[621]
<i>sinuosus</i>, <i>Polyporus</i> [Fr.:Fr. 1821]	487	[576]
<i>Sistotrema</i> [Fr.:Fr. 1821]	520, 606	[13, 618]
<i>sistotrema</i> [' <i>sistostrema</i> '], <i>Boletus</i> [Fr.:Fr. 1821]	414	[519]
<i>sistotremoides</i>, <i>Odontia</i> [(Schwein.:Fr.) Fr. 1838, comb. nov.]	529	[-]
= <i>Thelephora sistotremoides</i> Schwein.:Fr. 1822		
<i>sobolewskii</i>, <i>Hydnum</i> [Weinm. 1832]	517	[615]
<i>soloniensis</i>, <i>Polyporus</i> [(Dubois:Fr.) Fr. 1821]	461	[553]
= <i>Agaricus soloniensis</i> Dubois:Fr. 1803		
= <i>Boletus soloniensis</i> (Dubois:Fr.) DC. 1815		
<i>sordarius</i>, <i>Boletus</i> [Fr. 1838, sp. nov.]	419	[512]
= <i>Boletus rubeolarius</i> sensu Palmstr. 1805, non Bull. 1791		
<i>spadiceum</i>, <i>Hydnum</i> [Pers.:Fr. 1800]	508	[603]
= <i>Sistotrema spadiceum</i> (Pers.:Fr.) Sw. 1810		
= <i>Daedalea spadicea</i> (Pers.:Fr.) Fr. 1821		
<i>spadiceum</i>, <i>Stereum</i> [Fr. 1838, sp. nov.]	549	[640]
= <i>Thelephora spadicea</i> sensu Fr. 1828, non Pers.:Fr. 1801		

Taxon	Page	[Hym. Eur. page]
<i>spadiceus</i> , <i>Boletus</i> [Fr. 1838, nom. nov.]	415	[503]
nom. illegit., non <i>Boletus spadiceus</i> Krombh. 1836		
≡ <i>Boletus ferrugineus</i> Schaeff. 1774		
<i>Sparassis</i> [Fr.:Fr. 1819]	570, 607	[15, 666]
<i>spathularia</i> , <i>Guepinia</i> [(Schwein.:Fr.) Fr. 1828]	566	[–]
≡ <i>Merulius spathularia</i> Schwein.:Fr. 1822		
≡ <i>Cantharellus spathularia</i> (Schwein.:Fr.) Schwein. 1832		
<i>spathulata</i> , <i>Mitrula</i> [(O.F.Müll.) Fr. 1838, comb. nov.]	583	[–]
≡ <i>Clavaria spathulata</i> O.F.Müll. 1775		
≡ <i>Spathularia flavida</i> Pers.:Fr. 1794		
<i>spathulata</i> , <i>Sparassis</i> [(Schwein.:Fr.) Fr. 1828]	570	[–]
≡ <i>Merisma spathulatum</i> Schwein.:Fr. 1822		
<i>spathulatum</i> , <i>Hydnum</i> [Schwein.:Fr. 1822]	517	[614]
non <i>Hydnum spathulatum</i> Schrad.:Fr. 1794		
<i>spathulatus</i> , <i>Irpex</i> [(Schrad.:Fr.) Fr. 1828]	523	[622]
≡ <i>Hydnum spathulatum</i> Schrad.:Fr. 1794		
≡ <i>Sistotrema spathulatum</i> (Schrad.:Fr.) Pers. 1801		
<i>spathulatus</i> , <i>Polyporus</i> [(Hook.) Fr. 1838, comb. nov.]	443	[–]
≡ <i>Boletus spathulatus</i> Hook. 1822		
<i>speciosa</i> , <i>Thelephora</i> [Fr.:Fr. 1830]	536	[–]
<i>sphagnophilum</i> , <i>Geoglossum glabrum</i> var.		
[(Ehrenb.) Fr. 1838, comb. nov.]	583	[–]
≡ <i>Geoglossum sphagnophilum</i> Ehrenb. 1818		
<i>spiculosa</i> , <i>Thelephora</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	539	[637]
≡ <i>Thelephora cristata</i> β <i>T. spiculosa</i> Fr.:Fr. 1821		
<i>spinulosa</i> , <i>Clavaria</i> [Pers.:Fr. 1800]	574	[671]
<i>spissus</i> , <i>Polyporus</i> [Schwein. ex Fr.:Fr. 1828]	465	[–]
<i>spongiosa</i> , <i>Thelephora</i> [Schwein.:Fr. 1822]	541	[–]
<i>spongiosus</i> , <i>Merulius tremellosus</i> var. [Fr.:Fr. 1828]	500	[591]
<i>spongiosus</i> , <i>Polyporus nidulans</i> var.		
[(Pers.:Fr.) Fr. 1838, comb. nov.]	455	[548]
≡ <i>Boletus spongiosus</i> Pers.:Fr. 1801		
≡ <i>Polyporus spongiosus</i> (Pers.:Fr.) Fr. 1821		
<i>spumeus</i> , <i>Polyporus</i> [(Sowerby:Fr.) Fr. 1821]	459	[552]
≡ <i>Boletus spumeus</i> Sowerby:Fr. 1798–99		
<i>squalidus</i> , <i>Boletus</i> [Fr. 1835]	413	[501]
≡ <i>Boletus luteus-velifer</i> Secr. 1833, nom. inval.		
<i>squalidus</i> , <i>Merulius</i> [Fr.:Fr. 1828]	503	[594]
<i>squalidus</i> , <i>Polyporus</i> [Fr.:Fr. 1830]	469	[–]
<i>squalinum</i> , <i>Hydnum</i> [Fr.:Fr. 1821]	515	[612]
≡ <i>Sistotrema squalinum</i> (Fr.:Fr.) Pers. 1825		
<i>squamosum</i> , <i>Hydnum</i> [Bull. 1789]	505	[598]
<i>squamosus</i> , <i>Polyporus</i> [(Huds.:Fr.) Fr. 1821]	438	[532]
≡ <i>Boletus squamosus</i> Huds.:Fr. 1778		
<i>stabularis</i> , <i>Thelephora</i> [Fr.:Fr. 1821]	542	[658 as <i>Corticium stabulare</i>]

Taxon	Page	[Hym. Eur. page]
<i>stalactiticum</i>, <i>Hericium</i>		
[(Schrank) Fr. 1838, comb. nov., ' <i>stalactitium</i> ']	520	[607 sub <i>Hydnum</i> <i>coralloides</i>]
= <i>Hydnum stalactiticum</i> Schrank 1789		
= <i>Hericium abietinum</i> β <i>stalactiticum</i> (Schrank) Pers. 1797		
= <i>Hydnum coralloides</i> δ <i>H. stalactiticum</i> (Schrank) Pers. 1801		
<i>stalactitium</i> [sic], <i>Hericium</i> – See <i>stalactiticum</i> , <i>Hericium</i>		
<i>stereoides</i>, <i>Polyporus</i> [Fr.:Fr. 1818]	479	[569]
<i>Stereum</i> [Pers. 1794]	545, 607	[14, 638]
<i>stillatus</i>, <i>Dacrymyces</i> [Nees:Fr. 1816–17]	592	[699]
<i>stipatum</i>, <i>Hydnum</i> [Fr.:Fr. 1821]	519	[617]
<i>stipticus</i> [sic], <i>Polyporus</i> – See <i>stypiticus</i> , <i>Polyporus</i>		
<i>striaepes</i> [sic], <i>Boletus</i> – See <i>striipes</i> , <i>Boletus</i>		
<i>striata</i>, <i>Calocera</i> [(Hoffm.) Fr. 1838, comb. nov.]	582	[681]
= <i>Clavaria striata</i> Hoffm. 1795, non Pers.:Fr. 1797		
= <i>Clavaria cornea</i> γ <i>Clav. striata</i> (Hoffm.) Pers. 1801		
<i>striata</i>, <i>Clavaria</i> [Pers.:Fr. 1797]	578	[675]
<i>striatum</i>, <i>Stereum</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	548	[–]
non <i>Stereum striatum</i> (Schr.) Fr. 1838, p. 551		
= <i>Thelephora sericea</i> Schwein. 1822, nom. illegit., non Schrad. 1792		
= <i>Thelephora striata</i> Fr.:Fr. 1828		
<i>striatum</i>, <i>Stereum</i> [(Schr.) Fr. 1838, comb. nov.]	551	[641]
non <i>Stereum striatum</i> (Fr.:Fr.) Fr. 1838, p. 548		
= <i>Thelephora striata</i> Schrad. 1792, non Fr.:Fr. 1828		
<i>striatus</i>, <i>Polyporus</i> [Fr. 1838, nom. nov.]	480	[–]
nom. illegit., non <i>Polyporus striatus</i> (Humb.) Pers. 1825		
= <i>Boletus striatus</i> Hook. 1822, nom. illegit., non Humb. 1793		
<i>stricta</i>, <i>Calocera</i> [Fr. 1838, sp. nov.]	581	[680]
<i>stricta</i>, <i>Clavaria</i> [Pers.:Fr. 1795]	575	[673]
<i>strigosum</i>, <i>Hydnum</i> [Sw.:Fr. 1810]	514	[611]
<i>striipes</i>, <i>Boletus</i> [Secr. ex Fr. 1838, sp. nov., ' <i>striaepes</i> ']	414	[502 ' <i>striaepes</i> ']
= <i>Boletus striipes</i> Secr. 1833, nom. inval.		
<i>strobilaceus</i>, <i>Boletus</i> [Scop.:Fr. 1770]	422	[513]
<i>strumosus</i>, <i>Polyporus</i> [Fr. 1838, sp. nov.]	462	[–]
= ' <i>Fung. Guin. Lc.</i> ' [ined.]		
<i>stypiticus</i>, <i>Polyporus</i> [' <i>stipticus</i> '] [(Pers.:Fr.) Fr. 1821]	453	[546 ' <i>stipticus</i> ']
= <i>Boletus stypiticus</i> Per.:Fr. 1801		
<i>styracifluum</i>, <i>Stereum</i> [(Schwein.:Fr.) Fr. 1838, comb. nov.]	549	[–]
= <i>Thelephora styraciflua</i> Schwein.:Fr. 1822		
<i>suaveolens</i>, <i>Hydnum</i> [Scop.:Fr. 1772]	507	[602]
<i>suaveolens</i>, <i>Stereum</i> [(Moug. ex Fr.:Fr.) Fr. 1838, comb. nov.]	553	[644]
= <i>Thelephora suaveolens</i> Moug. ex Fr.:Fr. 1828		
<i>suaveolens</i>, <i>Trametes</i> [(L.:Fr.) Fr. 1838, comb. nov.]	491	[584]
= <i>Boletus suaveolens</i> L.:Fr. 1753		
= <i>Polyporus suaveolens</i> (L.:Fr.) Fr. 1821		
<i>subcarnaceum</i>, <i>Hydnum</i> [Fr.:Fr. 1818]	518	[615]

Taxon	Page	[Hym. Eur. page]
<i>subpileatus</i>, <i>Polyporus annosus</i> var.		
[(Weinm.:Fr.) Fr. 1838, comb. nov.]	472	[564 sub <i>Polyporus annosus</i>]
= <i>Polyporus subpileatus</i> Weinm.:Fr. 1826		
<i>subspadiceus</i> , <i>Polyporus</i> [Fr.:Fr. 1818]	482	[570]
<i>subsquamosum</i> , <i>Hydnum</i> [Batsch:Fr. 1783]	505	[598]
<i>subsquamosus</i> , <i>Polyporus</i> [(L.:Fr.) Fr. 1815]	428	[523]
= <i>Boletus subsquamosus</i> L.:Fr. 1753		
<i>substriatus</i> , <i>Polyporus</i> [Rostk.:Fr. 1828]	436	[532]
<i>subtile</i> , <i>Hydnum</i> [Fr.:Fr. 1821]	519	[617]
<i>subtile</i> , <i>Porothelium</i> [(Schr.:Fr.) Fr. 1832]	504	[595]
= <i>Boletus subtilis</i> Schrad.:Fr. 1794		
= <i>Polyporus subtilis</i> (Schr.:Fr.) Fr. 1821		
<i>subtilis</i> , <i>Clavaria</i> [Pers.:Fr. 1797]	573	[669]
<i>subtomentosa</i> , <i>Daedalea</i> [Schwein.:Fr. 1822]	493	[-]
<i>subtomentosus</i> , <i>Boletus</i> [L.:Fr. 1753]	415	[503]
<i>subzonatum</i>, <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	557	[-]
= <i>Thelephora subzonatum</i> Fr.:Fr. 1828		
<i>suecica</i> , <i>Clavaria</i> [Fr.:Fr. 1815]	575	[672]
<i>sulfureum</i> [sic], <i>Corticium</i> – See <i>sulphureum</i> , <i>Corticium</i>		
<i>sulfureum</i> [sic], <i>Hydnum</i> – See <i>sulphureum</i> , <i>Hydnum</i>		
<i>sulfureus</i>, <i>Boletus</i> [Fr. 1838, sp. nov.]	413	[502 'sulphureus']
nom. illegit., non <i>Boletus sulphureus</i> Bull.:Fr. 1789		
<i>sulfureus</i> [sic], <i>Polyporus</i> – See <i>sulphureus</i> , <i>Polyporus</i>		
<i>sulphureum</i>, <i>Corticium</i>		
[(Pers.Fr.) Fr. 1838, comb. nov., 'sulfureum']	561	[650]
nom. illegit., non <i>Corticium sulphureum</i> Pers. 1796		
= <i>Himantia sulphurea</i> Pers.:Fr. 1796		
= <i>Thelephora Himantia sulphurea</i> (Pers.:Fr.) Fr. 1821,		
non <i>Thelephora sulphurea</i> (Pers.) Pers. 1801		
[Fries initially included both <i>Himantia sulphureum</i> Pers. and <i>Corticium sulphureum</i> Pers. [= <i>Thelephora sulphurea</i> (Pers.) Pers.] under <i>T. Himantia sulphurea</i> (Fries 1821, p. 452); however, he later removed '[THELEPHORA] sulphurea P.' from the synonymy (Fries 1832, p. 189).]		
<i>sulphureum</i> ['sulfureum'], <i>Hydnum</i> [Schwein.:Fr. 1822]	516	[-]
<i>sulphureus</i> ['sulfureus'], <i>Polyporus</i> [(Bull.:Fr.) Fr. 1821]	450	[542]
= <i>Boletus sulphureus</i> Bull.:Fr. 1789		
<i>supinus</i> , <i>Polyporus</i> [(Sw.:Fr.) Fr. 1821]	471	[-]
= <i>Boletus supinus</i> Sw.:Fr. 1806		
<i>symphyton</i> , <i>Polyporus</i> [(Schwein.:Fr.) Fr. 1828]	460	[-]
= <i>Sistotrema symphyton</i> Schwein.:Fr. 1822		
<i>syringae</i> , <i>Dacrymyces</i> [(Schumach.:Fr.) Fr. 1822]	593	[698]
= <i>Tremella syringae</i> Schumach.:Fr. 1803		

T

<i>tabacinum</i>, <i>Stereum</i> [(Sowerby:Fr.) Fr. 1838, comb. nov.]	550	[641]
= <i>Auricularia tabacina</i> Sowerby:Fr. 1796–97		
= <i>Thelephora tabacina</i> (Sowerby:Fr.) Fr. 1821		

Taxon	Page	[Hym. Eur. page]
<i>tabacinus</i> , <i>Polyporus</i> [Mont. 1835]	477	[-]
<i>telfairii</i> [' <i>tilfairii</i> '], <i>Polyporus</i> [Klotzsch 1833]	450	[-]
<i>tenacella</i> , <i>Clavaria</i> [Pers.:Fr. 1797]	578	[675]
<i>tenuiculus</i> , <i>Favolus</i> [P.Beauv.:Fr. 1806]	499	[-]
= <i>Polyporus tenuiculus</i> (P.Beauv.:Fr.) Fr. 1821		
<i>tenuis</i>, <i>Hexagonia</i> [(Hook.) Fr. 1838, comb. nov.]	498	[-]
= <i>Boletus tenuis</i> Hook. 1822		
<i>tenuis</i> , <i>Typhula</i> [(Sowerby:Fr.) Fr. 1821]	586	[686]
= <i>Clavaria tenuis</i> Sowerby:Fr. 1800–03		
<i>tephroleucus</i> , <i>Polyporus</i> [Fr.:Fr. 1821]	452	[545]
<i>terrestris</i> , <i>Polyporus</i> [(DC.:Fr.) Fr. 1821]	486	[576]
= <i>Boletus terrestris</i> DC.:Fr. 1815		
<i>terrestris</i> , <i>Thelephora</i> [Ehrh.:Fr. 1787]	538	[635]
<i>tessellatus</i> [' <i>tessulatus</i> '], <i>Polyporus</i> [Fr.:Fr. 1818]	428	[523 ' <i>tessulatus</i> ']
<i>tessulatus</i> [sic], <i>Polyporus</i> – See <i>tessellatus</i> , <i>Polyporus</i>		
<i>testaceus</i>, <i>Polyporus</i> [Fr. 1838, sp. nov.]	453	[545]
= <i>Polyporus fumosus</i> sensu Fr. 1821, pro parte, non (Pers.:Fr.) Fr. 1818		
<i>tetragona</i> , <i>Clavaria</i> [Schwein. 1822]	572	[-]
<i>thamnoides</i>, <i>Thelephora</i> [Fr. 1838, sp. nov.]	538	[-]
<i>Thelephora</i> [Ehrh. ex Willd.:Fr. 1787]	534, 606	[14, 632]
<i>thelephoroides</i>, <i>Polyporus</i> [(Hook.) Fr. 1838, comb. nov.]	473	[-]
= <i>Boletus thelephoroides</i> Hook. 1822		
<i>tilfairii</i> [sic], <i>Polyporus</i> – See <i>telfairii</i> , <i>Polyporus</i>		
<i>todei</i> , <i>Typhula</i> [(Fr.:Fr.) Fr. 1818]	586	[685]
= <i>Mitrla todei</i> Fr.:Fr. 1815		
<i>tomentosum</i> , <i>Hydnum</i> [L.:Fr. 1753]	510	[606 sub <i>Hydnum cyathiforme</i>]
<i>tomentosum</i> , <i>Radulum</i> [Mont. & Fr. 1836]	525	[624]
<i>tomentosus</i> , <i>Polyporus</i> [Fr.:Fr. 1821]	434	[530]
<i>torosus</i> , <i>Boletus</i> [Fr. 1835]	417	[507]
<i>torrida</i>, <i>Trametes</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	490	[-]
= <i>Polyporus torridus</i> Fr.:Fr. 1828		
<i>tortus</i> , <i>Dacrymyces</i> [(Willd.:Fr.) Fr. 1828]	592	[698 sub <i>Dacrymyces deliquescens</i>]
= <i>Tremella torta</i> Willd.:Fr. 1788		
<i>trabeus</i> , <i>Polyporus</i> [Rostk.:Fr. 1830]	454	[547]
<i>Trametes</i> [Fr. 1836]	488, 605	[12, 581]
<i>Tremella</i> [Pers.:Fr. 1794]	588, 608	[16, 689]
<i>tremellosus</i> , <i>Merulius</i> [Schr.:Fr. 1794]	500	[591]
<i>tricholoma</i> , <i>Polyporus</i> [Mont. 1837]	431	[-]
<i>trichomorpha</i> , <i>Clavaria</i> [Schwein. 1822]	580	[679]
<i>tricolor</i>, <i>Hexagonia</i> [Fr. 1838, sp. nov.]	498	[-]
= ' <i>Fung. Guin. f. 8. c. descr.</i> ' [ined.]		
<i>triqueter</i>, <i>Polyporus</i> [Fr. 1838, sp. nov.]	474	[565]
nom. illegit., non <i>Polyporus triqueter</i> (Pers.) Pers. 1825		
= <i>Boletus triqueter</i> sensu Alb. & Schwein. 1805, non Pers. 1796		
<i>truncata</i> , <i>Exidia</i> [Fr.:Fr. 1822]	591	[693]

Taxon	Page	[Hym. Eur. page]
<i>tuba</i> , <i>Cyphella</i> [Fr. ex Weinm. 1836]	568	[664]
<i>tuberaster</i> , <i>Polyporus</i> [(Jacq. ex Pers.:Fr.) Fr. 1821]	428	[523]
= <i>Boletus tuberaster</i> Jacq. ex Pers.:Fr. 1801		
<i>tuberosa</i> , <i>Calocera</i> [(Sowerby:Fr.) Fr. 1832]	581	[680]
= <i>Clavaria tuberosa</i> Sowerby:Fr. 1798–99		
<i>tuberosa</i> , <i>Thelephora</i> [(Grev.:Fr.) Fr. 1828]	535	[634]
= <i>Merisma tuberosum</i> Grev.:Fr. 1825		
<i>tubulosa</i> , <i>Clavaria</i> [Fr.:Fr. 1828]	576	[–]
<i>tulipiferae</i> , <i>Irpex</i> [(Schwein.:Fr.) Schwein. 1832]	523	[–]
= <i>Boletus tulipiferae</i> Schwein.:Fr. 1822		
= <i>Polyporus corticola</i> d. <i>tulipiferae</i> (Schwein.:Fr.) Fr. 1828		
<i>Typhula</i> [(Pers.:Fr.) Fr. 1818]	584, 608	[15, 682]
= <i>Clavaria</i> γ <i>Typhula</i> Pers.:Fr. 1801		
U		
<i>udum</i> , <i>Hydnum</i> [Fr.:Fr. 1821]	517	[615]
<i>ulmarius</i> , <i>Polyporus</i> [(Sowerby:Fr.) Fr. 1821]	469	[562]
= <i>Boletus ulmarius</i> Sowerby:Fr. 1796–97		
<i>umbellatum</i> , <i>Hydnum</i> [Fr. 1838, nom. nov.]	511	[607]
= <i>Hydnum ramosissimum</i> L. Marchand & Courtois:Fr. 1828		
<i>umbellatus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1821]	446	[537]
= <i>Boletus umbellatus</i> Pers.:Fr. 1801		
<i>umbilicata</i> , <i>Hymenula</i> [(Pers.:Fr.) Fr. 1828]	594	[700]
= <i>Peziza umbilicata</i> Pers.:Fr. 1822		
<i>umbraculum</i> , <i>Polyporus</i> [Fr.:Fr. 1828]	435	[–]
<i>umbrina</i> , <i>Thelephora</i> [Fr.:Fr. 1828]	543	[658 as <i>Corticium umbrinum</i>]
= <i>Thelephora umbrina</i> ββ <i>lignatilis</i> Alb. & Schwein. 1805		
<i>umbrinus</i> , <i>Irpex</i> [Weinm. 1836]	521	[620]
<i>umbrinus</i> , <i>Merulius</i> [Fr.:Fr. 1828]	503	[594]
<i>uncialis</i> , <i>Clavaria</i> [Grev.:Fr. 1824]	580	[679]
<i>undatus</i> , <i>Polyporus</i> [Pers.:Fr. 1825]	476	[566 sub <i>Polyporus cryptarum</i>]
<i>undulata</i> , <i>Thelephora</i> [(Sw.:Fr.) Fr. 1828]	535	[633]
= <i>Merulius undulatus</i> Sw.:Fr. 1809, non Pers.:Fr. 1801		
= <i>Cantharellus undulatus</i> (Pers.:Fr.) Fr. 1821, sensu Fr., non sensu Pers.		
<i>undulatus</i> , <i>Polyporus</i> [(Schwein.:Fr.) Fr. 1828]	460	[–]
= <i>Boletus undulatus</i> Schwein.:Fr. 1822		
<i>unicolor</i> , <i>Daedalea</i> [(Bull.:Fr.) Fr. 1821]	494	[588]
= <i>Boletus unicolor</i> Bull.:Fr. 1789		
<i>unicolor</i> , <i>Polyporus</i> [Schwein. 1832]	458	[–]
= <i>Boletus unicolor</i> Schwein. 1822, nom. illegit., non Bull.:Fr. 1789		
<i>unicolor</i> , <i>Tremella</i> [Fr.:Fr. 1822]	589	[681 as <i>Calocera unicolor</i>]
<i>unitus</i> , <i>Polyporus</i> [Pers.:Fr. 1825]	482	[570]
<i>urticae</i> , ? <i>Dacrymyces</i> [(Pers.:Fr.) Fr. 1822]	593	[–]
= <i>Tremella urticae</i> Pers.:Fr. 1801		

Taxon	Page	[Hym. Eur. page]
<i>uvidum</i> , <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	565	[657]
= <i>Thelephora viscosa</i> β <i>uvida</i> Fr.:Fr. 1828		
V		
<i>vaccinus</i> , <i>Boletus</i> [Fr. 1838, sp. nov.]	420	[508]
= <i>Boletus castaneus</i> sensu Schumach. 1803, non Bull.:Fr. 1787–88		
<i>vaga</i> , <i>Phlebia</i> [Fr.:Fr. 1821]	527	[625]
<i>vaillantii</i> , <i>Polyporus</i> [(DC.:Fr.) Fr. 1821]	487	[579]
= <i>Boletus vaillantii</i> DC.:Fr. 1815		
<i>vaporarius</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1818]	487	[579]
= <i>Poria vaporaria</i> Pers.:Fr. 1794		
= <i>Boletus vaporarius</i> (Pers.:Fr.) Pers. 1801		
<i>variecolor</i> , <i>Hydnum</i> [Fr. 1838, sp. nov.]	516	[613]
= <i>Sistotrema quercinum</i> sensu Pers. 1825, pro parte		
<i>variegatus</i> , <i>Boletus</i> [Sw.:Fr. 1810]	413	[501]
<i>variegatus</i> , <i>Polyporus</i> [(Sowerby) Fr. 1838, comb. nov.]	470	[563]
= <i>Boletus variegatus</i> Sowerby 1800–03, non Sw.:Fr. 1810		
= <i>Polyporus variegatus</i> (Sowerby) Secr. 1833, nom. inval.		
<i>varius</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1821]	440	[535]
= <i>Boletus varius</i> Pers.:Fr. 1796		
<i>vegetus</i> , <i>Polyporus</i> [Fr. 1838, sp. nov.]	464	[556]
<i>velutinum</i> , <i>Corticium</i> [(DC.:Fr.) Fr. 1838, comb. nov.]	561	[650]
= <i>Thelephora velutina</i> DC.:Fr. 1815		
<i>velutinum</i> , <i>Hydnum</i> [Fr.:Fr. 1821]	508	[604]
<i>velutinus</i> , <i>Polyporus</i> [(Pers.:Fr.) Fr. 1821]	478	[568]
= <i>Boletus velutinus</i> Pers.:Fr. 1794		
<i>vermicularis</i> ['vermiculata'], <i>Clavaria</i> [Sw.:Fr. 1811]	577	[675]
<i>vermiculata</i> [sic], <i>Clavaria</i> – See <i>vermicularis</i> , <i>Clavaria</i>		
<i>vernalis</i> , <i>Clavaria</i> [Schwein. 1822]	580	[678 sub <i>Clavaria paludicola</i>]
<i>vernalis</i> , <i>Cyphella</i> [Weinm. 1832]	568	[663]
<i>verrucosus</i> ['verruculosus'], <i>Polyporus</i> [G.Mey.:Fr. 1818]	465	[–]
<i>verruculosus</i> [sic], <i>Polyporus</i> – See <i>verrucosus</i> , <i>Polyporus</i>		
<i>versicolor</i> , <i>Polyporus</i> [(L.:Fr.) Fr. 1821]	478	[568]
= <i>Boletus versicolor</i> L.:Fr. 1753		
<i>versicolor</i> , <i>Stereum</i> [(Sw.:Fr.) Fr. 1838, comb. nov.]	547	[–]
= <i>Helvella versicolor</i> Sw.:Fr. 1788		
= <i>Thelephora versicolor</i> (Sw.:Fr.) Sw. 1806		
<i>versiforme</i> , <i>Corticium</i> [(Fr.:Fr.) Fr. 1838, comb. nov.]	559	[647]
= <i>Thelephora versiformis</i> Fr.:Fr. 1828		
<i>versipellis</i> , <i>Boletus</i> [Fr. 1835]	424	[515]
<i>vespacea</i> , <i>Hexagonia</i> [(Pers.) Fr. 1838, comb. nov.]	497	[–]
= <i>Polyporus vespaceus</i> Pers. 1827		
<i>villosa</i> , <i>Typhula</i> [(Schumach.:Fr.) Fr. 1821]	585	[683]
= <i>Clavaria villosa</i> Schumach.:Fr. 1803		
<i>villosus</i> , <i>Polyporus</i> [(Sw.:Fr.) Fr. 1821]	475	[–]
= <i>Boletus villosus</i> Sw.:Fr. 1788		

Taxon	Page	[Hym. Eur. page]
violaceolividum, Corticium		
[(Sommerf.) Fr. 1838, comb. nov.]	564	[655]
= <i>Thelephora violaceolivida</i> Sommerf. 1826		
violaceus, Craterellus [(Haller ex Fr.:Fr.) Fr. 1838, comb. nov.] .	533	[631]
= <i>Merulius violaceus</i> Haller ex Fr.:Fr. 1818, non O.F.Müll. 1775, nec Pers. 1797		
= <i>Cantharellus violaceus</i> (Haller ex Fr.:Fr.) Fr. 1821		
violaceus, Dacrymyces [(Relhan:Fr.) Fr.1822]	592	[692 as <i>Tremella violacea</i>]
= <i>Tremella violacea</i> Relhan:Fr. 1785		
violaceus, Merulius [Pers. 1797]	501	[646 sub <i>Auricularia</i>]
nom. illegit., non <i>Merulius violaceus</i> O.F.Müll. 1775, <i>mesenterica</i>]		
nec Haller ex Fr.:Fr. 1818		
violaceus, Polyporus [Fr.:Fr. 1818]	484	[572]
violascens, Hydnum [Alb. & Schwein.:Fr. 1805]	507	[602]
violascens, Thelephora [(Fr.:Fr.) Fr. 1821]	543	[658 as <i>Corticium violascens</i>]
= <i>Himantia violascens</i> Fr.:Fr. 1815		
virellus, Polyporus [Fr. 1838, sp. nov.]	429	[525]
virens, Tremella [Schwein.:Fr. 1822]	589	[-]
virescens, Dacrymyces [(Schumach.:Fr.) Fr. 1822]	592	[696 as <i>Naematelia virescens</i>]
= <i>Tremella virescens</i> Schumach.:Fr. 1803		
virgata, Clavaria [Fr.:Fr. 1821]	573	[670]
virgineus, Polyporus [(Schwein.:Fr.) Fr. 1828]	481	[-]
= <i>Boletus virgineus</i> Schwein.:Fr. 1822		
viride, Geoglossum [(Holmsk.:Fr.) Pers. 1796]	582	[-]
= <i>Clavaria mitrata</i> var. <i>viridis</i> Holmsk.:Fr. 1790		
= <i>Clavaria viridis</i> (Holmsk.:Fr.) Schrad. 1792		
viride, Hydnum [(Alb. & Schwein.:Fr.) Fr. 1821]	517	[614]
= <i>Sistotrema viride</i> Alb. & Schwein.:Fr. 1805		
viscidus, Boletus [L. 1753]	423	[513]
viscosa, Calocera [(Pers.:Fr.) Fr. 1828]	581	[680]
= <i>Clavaria viscosa</i> Pers.:Fr. 1794		
viscosum, Corticium [Pers.:Fr. 1800]	563	[652 sub <i>Corticium lividum</i>]
= <i>Thelephora viscosa</i> (Pers.:Fr.) Pers. 1801		
viscosum, Geoglossum [Pers.:Fr. 1797]	583	[-]
viscosus, Polyporus [Pers.:Fr. 1825]	429	[525]
vitellinus, Hypochnus [Mont. ex Fr. 1838, nom. nov.]	570	[-]
= <i>Hypochnus holoxanthus</i> Mont. 1837		
vitellinus, Polyporus [(Schwein.:Fr.) Fr. 1828]	483	[-]
= <i>Boletus vitellinus</i> Schwein.:Fr. 1822		
viticola, Corticium [(Schwein.:Fr.) Fr. 1838, comb. nov.]	561	[-]
= <i>Thelephora viticola</i> Schwein.:Fr. 1822		
viticola, Polyporus [Schwein. ex Fr.:Fr. 1828]	482	[-]
vitreus, Polyporus [(Pers.:Fr.) Fr. 1818]	485	[577]
= <i>Poria vitrea</i> Pers.:Fr. 1796		
= <i>Boletus vitreus</i> (Pers.:Fr.) Pers. 1801		
vorticolum, Stereum [(Fr.) Fr. 1838, comb. nov.]	548	[639]
= <i>Thelephora vorticosa</i> Fr. 1818		

Taxon	Page	[Hym. Eur. page]
<i>vulgaris</i> , <i>Hymenula</i> [(Fr.:Fr.) Fr. 1832]	594	[701]
= <i>Hymenella vulgaris</i> Fr.:Fr. 1822		
<i>vulgaris</i> , <i>Polyporus</i> [Fr.:Fr. 1821]	485	[577]

W

weinmanni [sic], <i>Hydnum</i> – See <i>weinmannii</i> , <i>Hydnum</i>		
weinmanni [sic], <i>Polyporus</i> – See <i>weinmannii</i> , <i>Polyporus</i>		
<i>weinmannii</i> [' <i>weinmanni</i> ?'], <i>Hydnum</i> [Fr.:Fr. 1828]	516	[613 ' <i>weinmanni</i> ']
<i>weinmannii</i>, <i>Polyporus</i> [Fr. 1838, sp. nov., ' <i>weinmanni</i> ?']	459	[552 ' <i>weinmanni</i> ?']
= <i>Polyporus labyrinthicus</i> sensu Weinm. 1836, non Fr.:Fr. 1828		
<i>wightii</i>, <i>Hexagonia</i> [(Klotzsch) Fr. 1838, comb. nov., ' <i>wrightii</i> ?']	496	[–]
= <i>Polyporus wightii</i> Klotzsch 1833		
wirtgeni [sic], <i>Polyporus</i> – See <i>wirtgenii</i> , <i>Polyporus</i>		
<i>wirtgenii</i>, <i>Polyporus</i> [Fr. 1838, sp. nov., ' <i>wirtgeni</i> ?']	483	[570 ' <i>wirtgeni</i> ?']
= <i>Polyporus bombycinus</i> sensu Wirtg. 1835, non Fr.:Fr. 1828		
wrightii [sic], <i>Hexagonia</i> – See <i>wightii</i> , <i>Hexagonia</i>		

X

<i>xanthopus</i> , <i>Polyporus</i> [Fr.:Fr. 1818]	437	[–]
<i>xanthus</i> , <i>Polyporus</i> [Fr.:Fr. 1815]	483	[574]
<i>xoilopus</i> , <i>Polyporus</i> [Rostk.:Fr. 1828]	429	[525]

Z

<i>zonata</i> , <i>Daedalea</i> [Schwein. 1822]	494	[588]
<i>zonatum</i> , <i>Hydnum</i> [Batsch 1783]	509	[605]
<i>zonatus</i> , <i>Polyporus</i> [(Nees:Fr.) Fr. 1821]	478	[568]
= <i>Boletus zonatus</i> Nees:Fr. 1816–17		

***Astrosphaeriella linguiformis*, a new species on bamboo**

CHI YU CHEN & JENN WEN HUANG*

chiyu86@dragon.nchu.edu.tw *jwhuang@dragon.nchu.edu.tw
Department of Plant Pathology, National Chung Hsing University
250 Kuo Kuang Rd, Taichung 402, Taiwan

Abstract—*Astrosphaeriella linguiformis* is described from culms of bamboos in Taiwan. The characteristic tongue-like appendage at one end of ascospores distinguishes this species from other members of *Astrosphaeriella*.

Key words—loculoascomycetes, taxonomy, bambusicolous fungi

Introduction

Astrosphaeriella Syd. & P. Syd. was reintroduced by Hawksworth (1981) to accommodate four loculoascomycetous species with characteristic hemispherical to conical ascomata and occurring on monocotyledonous hosts. The generic concept was afterwards extended to include five additional species (Hawksworth & Boise 1985). Hyde & Fröhlich (1998) adopted the extended concept and, accordingly, reviewed this genus, in which they accepted 31 species. Additional species were provided by Chen & Hsieh (2004), Hyde et al. (2000), Rogers & Barr (2003), San Martín & Lavín (1999), Tanaka & Harada (2005), and Wang et al. (2004). Presently 45 taxa are accepted in *Astrosphaeriella*. In a continuous survey of fungal diversity in Taiwan, a fungus colonizing culms of bamboos was found belonging to the genus *Astrosphaeriella*. By virtue of its conical, carbonaceous ascomata surrounded by star-like host fragments, this species most closely resembles the generic type. As the tongue-like appendage at the basal end of ascospores is unlike that of any *Astrosphaeriella* species, a new species, *Astrosphaeriella linguiformis*, is proposed for this fungus. Specimens examined are deposited at National Museum of Natural Science (TNM) and National Chung Hsing University (NCHUPP). Single ascospore isolations were made to obtain pure cultures, but no asexual spores were produced. The ex-type culture is deposited at BCRC (Bioresource Collection and Research Center).

*corresponding author

Taxonomy

Astrosphaeriella linguiformis Chi Y. Chen & J.W. Huang, sp. nov.

MYCOBANK 510154

(Fig. 1)

*Mycelium subepidermali*um, *stromate efficientium*. *Ascomata dispersa, erumpentia, superficialia ubi maturitate, conica, 400–700 µm lata, 300–500 alta, apice rotundo, non papillato, basibus cortice hospitis cinctis. Paries ascomatis 25–35 µm crassus, carbonaceus. Asci cylindrici, 130–160 × 14–18 µm, brevipedicellati, 8-spori. Pseudoparaphyses 1.5–2.5 latae, ramosae. Ascospores irregulariter biseriatae in asco, ellipsoideae vel fusiformes, 24–34 × 6–8 µm, glabrae, pallide brunneae, septo primo submedio, vagina tenui obtectae, cum vagina postica protracta et linguiformi.*

Etymology: From Latin “lingua” means “tongue” and “formis” means “formed”, in reference to the tongue-shaped appendage.

Holotype: TAIWAN. PINTUNG HSIEN: Henchun, Kenting, on unknown bamboo, 24 Dec. 2002, C.Y. Chen, *TNM F19957*; culture ex-type *BCRC 33879*.

Mycelium subepidermal, extensively connecting adjacent *ascomata*, forming *stromatic tissue*, which is particularly prominent around *ascomata*. *Ascomata* scattered, immersed at first, at maturity *erumpent* through the host tissue with ruptured host remnants surrounding the *ascomata* and appearing star-like in surface view, conical, 400–700 µm wide, 300–500 µm high, apex non-papillate, flattened at base. *Peridium* at sides carbonaceous, 25–35 µm thick, composed of melanized, opaque cells except at the inner cell layers of lateral rim where the cells are hyaline and elongated in palisade-like rows; *peridium* at base much reduced, composed of cells interwoven with host tissue. *Asci* cylindrical, 130–160 × 14–18 µm, short-stalked, 8-spored. *Pseudoparaphyses* embedded in gelatinous matrix, frequently branched and anastomosing, 1.5–2.5 µm wide. *Ascospores* irregularly biseriate in *ascus*, ellipsoid to fusiform, 24–34 × 6–8 µm, smooth, pale brown, with a conspicuously constricted, submedian septum, surrounded by a sheath which expands around the lower cell and is drawn out at the posterior end to form a tongue-like appendage, up to 20 µm long.

Other specimens examined: TAIWAN. HUALIEN HSIEN: Hsiulin county, Tienhsiang, on *Phyllostachys* sp., 28 Dec. 2001, C.Y. Chen, *NCHUPP c0427*. KAOHSIUNG HSIEN: Taoyuan county, Meishan, on *Phyllostachys* sp., 25 Aug. 2001, C.Y. Chen, *NCHUPP c0304*; Taoyuan county, Tengchih, on *Phyllostachys* sp., 18 Dec. 2003, C.Y. Chen, *TNM F19958*.

Discussion

Under the current accepted circumscription of *Astrosphaeriella* (Hawksworth & Boise 1985), three groups of species can be recognized in this genus (Chen & Hsieh 2004): typical *Astrosphaeriella* species (containing species most closely related to the generic type), *Trematosphaeria*-like species, and *Massarina*-like species. The similarity of *Astrosphaeriella* to *Trematosphaeria* Fuckel and

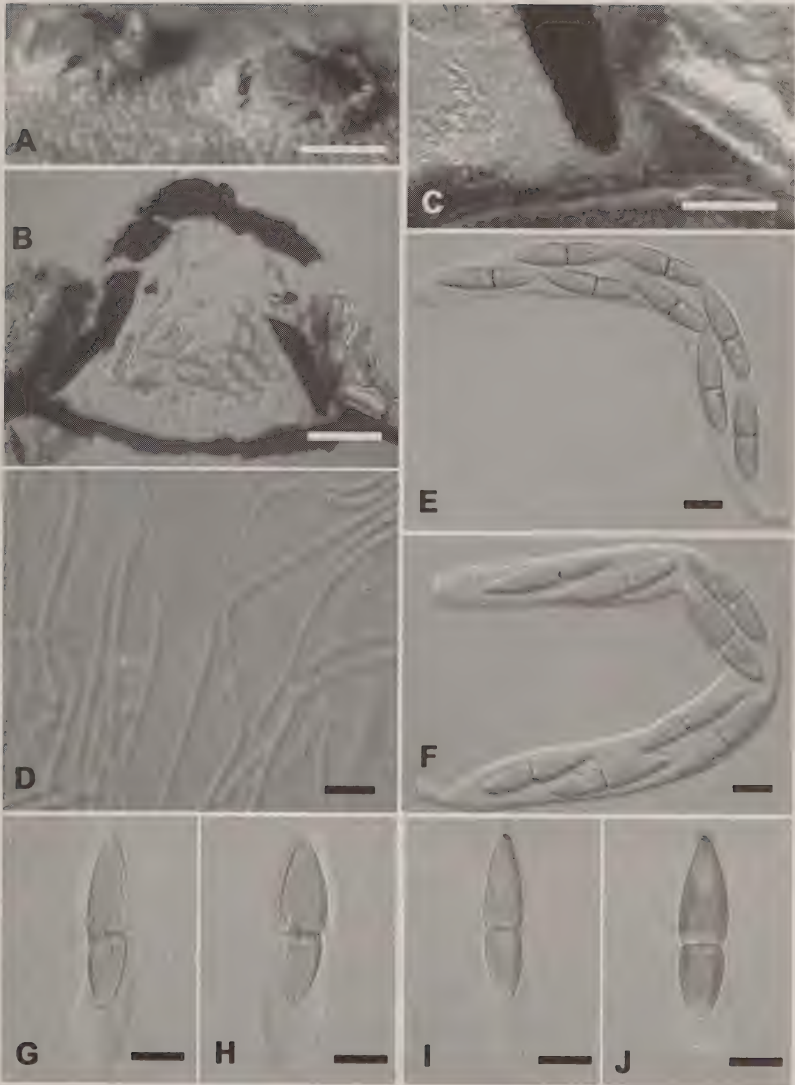


Figure 1. *Astrosphaeriella linguiformis* (from holotype). A. Ascomata on host surface. Note the ruptured host remnants. B. Section of ascoma. C. Close-up view of B, showing the lateral rim of ascoma. D. Pseudoparaphyses. E–F. Asci. G–J. Ascospores. Scale bars, A = 300 μ m; B = 100 μ m; C = 40 μ m; D–J = 10 μ m.

Massarina Sacc. has also been reported by Boise (1985) and Aptroot (1998) respectively. This suggests that there are ambiguities in the circumscriptions among these related genera. However *Astrosphaeriella linguiformis* apparently does not belong to *Trematosphaeria* or *Massarina*, as possessing the superficially appearing ascomata flanked by star-like host remnants, the most significant feature that characterizes the generic type, *A. stellata* (Pat.) Sacc. Accordingly this fungus undoubtedly belongs to the group of "typical *Astrosphaeriella* species" in the sense of Chen & Hsieh (2004). This fact warrants it being a good species in this genus even though the genus is eventually proved heterogeneous and certain species are to be removed from the genus. As the ascospores possessing a significantly submedian septum and a tongue-like appendage are unique in the genus, the recognition of a new species is warranted.

In the collections TNM F19958 (Fig. 2) and NCHUPP c0304, nearly all ascospores examined are hyaline, and prior to the formation of appendage these hyaline ascospores usually give the appearance of having a median septum. However, the occasional existence of brown ascospores with the characteristic tongue-like appendage reveals that the identity of these two collections is *A. linguiformis*. These hyaline ascospores are apparently immature, and the two specimens should be considered in young stage. It is likely that the ascospores are subjected to a prolonged maturing process, which may account for the fact that hyaline ascospores are dominant in some collections. It is worth noting that the tongue-like appendage is derived from part of the lower cell of ascospores based upon the observation of different stages of immature ascospores.

Acknowledgements

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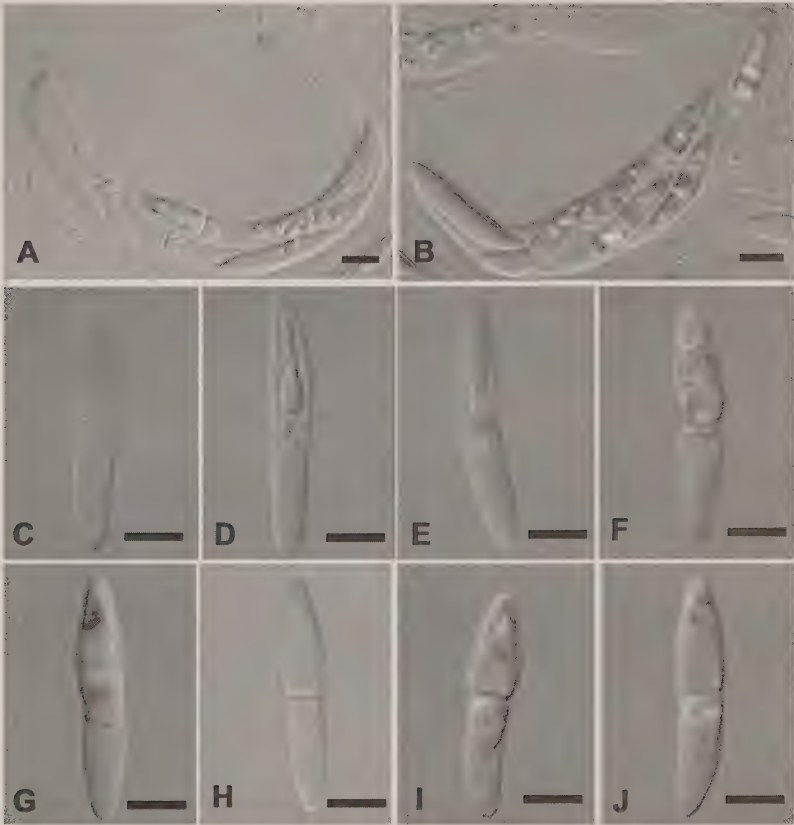


Figure 2. Immature stage of *Astrosphaeriella linguiformis* (from TNM F19958). A–B. Asci. C–J. Ascospores, showing different stages of maturity. Note the development of appendage. Scale bars A–J= 10 μ m.

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***Septoria malagutii* sp. nov.,
cause of annular leaf spot of potato**

ERICA T. CLINE¹ & AMY Y. ROSSMAN¹

ecline@u.washington.edu amy@nt.ars-grin.gov

Systematic Botany & Mycology Laboratory

USDA-ARS, 10300 Baltimore Ave., Beltsville, Maryland, USA

Abstract—The fungus causing annular leaf spot of potato, reported only from South America, poses a risk as a potentially invasive species due to its ability to flourish in the cooler temperatures typical of potato-producing regions in Europe and North America. Initially described as “*Septoria lycopersici* var. *malagutii*”, the variety is not validly published as required by the International Code of Botanical Nomenclature because no type specimen was specifically designated. Specimens of *S. lycopersici* var. *lycopersici* and *S. lycopersici* “var. *malagutii*” were examined and their rRNA ITS regions and (TEF)-1 α genes were sequenced. The ‘var. *malagutii*’ conidia were significantly longer and narrower with the conidiogenous cells significantly shorter and narrower than the “var. *lycopersici*” cells. Although the sequences were similar — ITS at 99.6% and TEF-1 α at 99.2% — the “var. *lycopersici*” ITS was more similar to several other *Septoria* species than to its “var. *malagutii*” counterpart, suggesting that the latter should be recognized as a new species: *Septoria malagutii*.

Key words—plant pathogen, plant quarantine, systematics, translation elongation factor, internal transcribed spacer

Introduction

Annular leaf spot (‘mancha anular foliar’) is a fungal disease affecting wild and cultivated varieties of potatoes, including *Solanum andigenum* Juz. & Bukasov, *S. tuberosum* L., and other tuber-forming *Solanum* spp. in the “species series” *tuberosa* (*Solanaceae*; Jimenez & French 1972). The disease has been documented to occur in the Andes mountains of South America at elevations above 3000 m in Peru (Torres et al. 1970), above 1700 m in Venezuela (Piglionica et al. 1978), above 3000 m in Ecuador (Carrera & Orellana 1972), and may also occur in Bolivia (Smith et al. 1992). It is reportedly restricted to higher elevations of South America due to its growth requirement for cool temperatures (Piglionica et al. 1978).

The European Plant Protection Organization (EPPO) has listed “*Septoria lycopersici* var. *malagutii*” as an A1 quarantine pest to restrict it from spreading

to cool and humid regions outside of South America, where it could be a potentially dangerous potato pathogen (Smith et al. 1992). The Andes of South America are widely accepted as the site of origin and the center of diversity for native potatoes (Ochoa 1991). Despite its possible invasive potential, "*S. lycopersici* var. *malagutii*" has received little taxonomic attention since initial publication of the species description (Piglionica et al. 1978).

The fungus causing annular leaf spot of potato was described by Jimenez & French (1972) as "Strain A" of *Septoria lycopersici* Speg., a common, cosmopolitan pathogen on leaves of tomato, *Lycopersicon esculentum* Mill., sometimes included in the genus *Solanum* (Spooner et al. 1993). Citing its distinctive host range and preference for cooler temperatures as well as the brown discoloration of the agar, Piglionica et al. (1978) described this fungus as a new variety, "*Septoria lycopersici* var. *malagutii*". In the initial description of "*S. lycopersici* var. *malagutii*", conidia from agar cultures were described as "4-6 septate and 60-95 x 1.7 μ m". Other characters were described as identical to the type variety. Unfortunately, the authors did not specifically designate a holotype specimen as required by the International Code of Botanical Nomenclature (Greuter et al. 2000, Art. 37.1, Note 1); rather they mention co-types at three different institutions. As a result, this must be regarded as an invalid name. We will refer to it from this point on as *Septoria malagutii* and the typical variety, *S. lycopersici* var. *lycopersici*, as simply *S. lycopersici*.

Septoria lycopersici has not been known to occur on potatoes nor has *S. malagutii* been reported to occur on tomatoes in nature. In inoculation studies, *S. malagutii* was able to infect leaves of cultivated tomatoes, but produced smaller lesions than *S. lycopersici* (Piglionica et al. 1978). When inoculated on potato, *S. lycopersici* was able to infect leaves, but produced only sterile lesions (Jimenez & French 1972). Both taxa were able to infect *Datura stramonium* L. but were unable to infect *Physalis peruviana* L. (Jimenez & French 1972). In culture, *Septoria malagutii* had maximal growth at 21° C and was unable to grow at temperatures at or above 28° C. In contrast, *S. lycopersici* had maximal growth at 24° C and growth persisted at temperatures up to 28° C (Piglionica et al. 1978).

No teleomorph has been reported for *Septoria lycopersici* or *S. malagutii*. In a recent phylogenetic analysis of ITS and LSU nuclear ribosomal DNA, all 17 *Septoria* species were associated with the monophyletic teleomorphic genus *Mycosphaerella* Johanson (*Dothideales*) (Verkley et al. 2004a, b). However, the anamorphic genus *Septoria* was not monophyletic within *Mycosphaerella*. There was no support for separation of *Septoria* from *Phloeospora*, but the type of *Septoria*, *S. cytisi* Desm., was not included in the study (Verkley et al. 2004b). Several species of *Septoria* on hosts in varying plant genera or families had identical D2 (LSU) sequences and similar ITS sequences (Verkley et al. 2004b).

Verkley et al. (2004b) concluded that, in the absence of clear morphological differences, host specificity alone may not provide a reliable basis for differentiating species.

Our objectives were to 1) evaluate the taxonomic status of “*Septoria lycopersici* var. *malagutii*”, 2) validate and redescribe *Septoria malagutii* as a new species, 3) explore the degree of relatedness of *S. lycopersici* (var. *lycopersici*) and *S. malagutii* by comparing their morphology in culture and sequence homology of ITS rRNA and the TEF-1 α gene, and 4) evaluate the potential connection of *Septoria lycopersici* and *S. malagutii* to the teleomorphic genus *Mycosphaerella*. Such knowledge will facilitate identification and management of this pathogen and significant quarantine organism.

Materials and methods

Cultures were obtained from the Centraal Bureau voor Schimmelcultures (CBS). *Septoria lycopersici* var. *lycopersici* CBS 353.49 (ATCC 9685) was isolated and identified by S.P. Doolittle in 1945 from *Lycopersicon esculentum* (location unknown); *S. lycopersici* var. *lycopersici* CBS 354.49 (IMI 100277) was isolated and identified by B.H. MacNeill from *L. esculentum* in Ontario, Canada, and deposited June 1949 by M. Bakker; *S. malagutii* (as “*S. lycopersici* var. *malagutii*,”) CBS 106.80 (PD 75/912) was collected by L.J. Turkensteen in 1975 from Peru, Dep. Junin, Huasahuasi, at an altitude of 3000 m, on leaves of *Solanum* sp. in the series *tuberosa*, and identified and deposited by G.H. Boerema, Jan. 1980.

Cultural morphology and growth rates were assessed and DNA was extracted from isolates growing on potato dextrose agar (PDA, Difco Labs, Detroit, Michigan, U.S.A.). Attempts to induce sporulation were performed under supplemental fluorescent light on synthetic nutrient agar (SNA, Gerlach & Nirenberg 1962) with and without filter paper and on water agar (WA) with sterile alfalfa twigs incubated for up to 60 days. Terminology in describing cultures follows Nobles (1948). Color names were chosen with reference to standard mycology color charts (Raynor 1970).

Specimen #2029 was provided by the Plantenziektenkundige Dienst Wageningen, labeled “*Septoria lycopersici* Speg. var. *malagutii* Ciccarone et Boerema,” host *Solanum tuberosum*, location Llicllatambo, Peru, alt. 3700 m, collected by H. Torres, Oct. 1979, received from Turkensteen, determined by W.M. Loerakker. Specimens of *Septoria lycopersici* var. *lycopersici* were obtained from the U.S. National Fungus Collections: BPI 381364 *S. lycopersici*, host *Lycopersicon esculentum*, from Unionville, CT USA, Aug. 26 1902, collected and determined by G.P. Clinton; BPI 381365, *S. lycopersici*, host *L. esculentum*, from Westville CT, USA, Aug. 28, 1902, collected and determined by G.P. Clinton; BPI 381366, *S. lycopersici*, host *L. esculentum*, from New Haven, CT, USA, Aug. 17, 1902, collected and determined by G.P. Clinton; BPI 381367, *S. lycopersici*, host *L. esculentum*, from New Haven, CT, USA, Oct. 4 1928, collected by A.D. McDonnell, determined by A.A. Dunlop; BPI 381509, *S. lycopersici*, host *L. esculentum*, from Cranja Agrícola, Roldanillo (Valle), Colombia, May 26, 1939, collected by C. Garces O., determined by A.J. Watson; BPI 522039 (#1786, 1109 Herb. of John Sheldon), *S. lycopersici*, host *L. esculentum*, from Willow Grove, WV, USA, July 18 1905, collected

by A.L. Post; BPI 522032, *S. lycopersici*, host *L. esculentum*, London, Canada, Sept. 1898, collected by J. Dearness; BPI 381513, *S. lycopersici*, host *L. esculentum*, from Sanare, Venezuela, alt. 4700 ft., July 27 1949, collected by W.F. Jeffers, determined by P.L. Lentz.

Specimens and cultures were mounted in 5% KOH with or without addition of phloxine dye and examined using a Zeiss Stemi SVII Apo dissecting microscope and a Zeiss Axiophot DIC microscope with a Nikon DXM 1200F digital camera. Images were processed using the Nikon ACT-1 software package (Version 2.63, ©2000 Nikon Inc.). Measurements were taken using the *Taxonomica* program designed by M. Sogonov to run on a Microsoft ACCESS 1997 platform. Analysis of dimensions of conidia and conidiogenous cells was performed using the Microsoft Excel statistical package.

Genomic DNA was extracted from actively growing PDA cultures using the Ultraclean Plant DNA Isolation kit standard protocol (MoBio Inc., Carlsbad, California, U.S.A.). The internal transcribed spacer (ITS) of the ribosomal RNA was amplified via polymerase chain reaction (PCR) using the primer pair ITS-1F/ITS4 (White et al. 1990). Two overlapping portions of the translation elongation factor (TEF)-1 α gene were amplified with the primer pairs 526F/1567R and 983F/2218R using a touchdown protocol with 45 cycles as described by Rehner & Buckley (2005). Sequencing reactions were performed using the BigDye[®] (Applied Biosystems, Foster City, California, U.S.A.), using the primers ITS-1F and ITS-4 for ITS (White et al. 1990), and 983F, EF-cf, EF-df, 1577f, 2218R, 1953R, EF-gr, and 1567R for TEF-1 α (Rehner & Buckley, 2005) run on an ABI 3100 sequencer. Sequences were assembled using the Sequencher software program (Gene Codes Inc., Ann Arbor MI, U.S.A.), aligned and analyzed using the MEGA software package version 3.1 (Kumar et al., 2004), and adjusted manually as needed. Sequences have been submitted to GenBank under the accession numbers DQ 841154-DQ841159.

Results

Conidiogenous cells of *Septoria malagutii* (Fig. 1) were significantly shorter than those of *S. lycopersici* (Fig. 2), $7.4 \pm 0.2 \mu\text{m}$ compared to $9.1 \pm 0.3 \mu\text{m}$ (mean $\pm$ standard error of the mean, $T_{(2,118)} = 4.66$, $P = 8 \times 10^{-6}$). Conidiogenous cells of *S. malagutii* were also significantly narrower, $3.6 \pm 0.1 \mu\text{m}$ compared to $4.1 \pm 0.1 \mu\text{m}$ for *S. lycopersici* ($T_{(2,118)} = 2.9$, $P = 0.005$). Conidiogenous cells of *S. malagutii* and *S. lycopersici* were just over twice as long as they were wide. The ratio of length to width was not significantly different, 2.3 ± 0.1 for both species ($T_{(2,118)} = 0.5$, $P = 0.7$).

Conidia of *Septoria malagutii* (Figs 3, 4) were longer than those of *S. lycopersici* (Figs 5, 6), $90.6 \pm 3.4 \mu\text{m}$ compared to $73.2 \pm 2.4 \mu\text{m}$ (mean $\pm$ standard error of the mean). The difference was significant with $\alpha = 0.05$ based on a two sample Student's T-test assuming equal variance ($T_{(2,103)} = 4.23$, $P = 0.00005$). Conidia of *S. malagutii* were significantly narrower, $1.9 \pm 0.03 \mu\text{m}$ compared to $2.2 \pm 0.05 \mu\text{m}$ for *S. lycopersici* ($T_{(2,103)} = 3.89$, $P = 0.0002$). Conidial length to width ratios were significantly greater for *S. malagutii*, 47.8 ± 1.9 compared to 33.4 ± 1.2 for *S. lycopersici* ($T_{(2,103)} = 6.35$, $P = 6.0 \times 10^{-9}$). Conidia of *S. malagutii*

had 4.3 ± 0.2 septae while conidia of *S. lycopersici* had 4.7 ± 0.3 septae, not significantly different ($T_{(2,98)} = 1.2$, $P = 0.23$).

Although colonies of *Septoria malagutii* and *S. lycopersici* appear similar on the surface (Figs 7, 8), when viewed in reverse, these colonies vary. The *S. malagutii* culture was brown-vinaceous in reverse, with one sector producing a livid red pigment (Figs 7, 9), while the *S. lycopersici* cultures (Figs 8, 10) were salmon-colored in reverse.

The ITS and TEF-1 α sequences for two cultures of *Septoria lycopersici* (CBS 353.49 and CBS 354.49) (Figs 7, 9) were identical. Sequences of *S. malagutii* differed from *S. lycopersici* at two nucleotides within the ITS region, consisting of ITS-1, 5.8S rRNA, and ITS-2, totalling 549 bp (one transition, one transversion, 0.4% difference). The PCR amplification of the TEF-1 α sequence using the 526F/1567R primer pair for *S. malagutii* (CBS 106.80) was unsuccessful, therefore only 895 bp from the 983F/2218R primer pair could be compared to *S. lycopersici*. Over this region of the EF-1 α gene, *S. malagutii* differed from *S. lycopersici* at seven nucleotides (four transitions, three transversions, 0.8% difference).

Discussion

Verkley et al. (2004b) have suggested that host specificity alone may not reliably differentiate among species in the genus *Septoria*. Here we reinforce the distinction of the two species based on differences in host range by presenting morphological and molecular evidence to justify treatment of *S. malagutii* as a species distinct from *S. lycopersici*.

Measurements of morphological characters from specimens of *S. malagutii* and *S. lycopersici* displayed considerable overlap. Nevertheless, there were significant differences in conidial length and width and conidiogenous cell length and width that allow for separation of these two species. The ratio of length to width may prove particularly useful in distinguishing the longer and narrower conidia of *S. malagutii* from those of *S. lycopersici*. Qualitative morphological characters also help to differentiate the two taxa. The conidia of *S. malagutii* are frequently curved or sigmoid and pointed at both ends (Figs. 3, 4), while those of *S. lycopersici* are truncate to obtuse at the base (Figs. 5, 6; Sutton & Waterston 1966).

In this study, infertile pycnidia of *Septoria malagutii* were produced in culture on SNA with filter paper with supplemental fluorescent light, while no pycnidia were produced on SNA with alfalfa twigs. Jimenez & French (1972) reported that sporulation of *S. malagutii* could be induced on V8-agar or corn meal agar at 20° C with supplemental fluorescent light. Carerra & Orellana (1978) found that pycnidia of *S. malagutii* on all media tested were infertile; fertile conidiomata were only produced on Lima bean agar.

Based on ITS sequence homology, *S. malagutii* is closely related to other species currently accepted in the genus *Septoria*. The genus *Septoria* was demonstrated by Verkley et al. (2004b) to be polyphyletic, therefore the generic concept may be subject to future revision. Unfortunately, the ITS sequence of the type species *S. cytisi* is not available for comparison to that of *S. malagutii*. In phylogenetic analysis (data not shown), the ITS sequences of *S. lycopersici* and *S. malagutii* were placed within the monophyletic clade representing the teleomorphic genus *Mycosphaerella* (Verkley et al. 2004b).

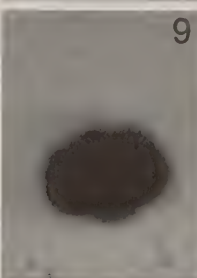
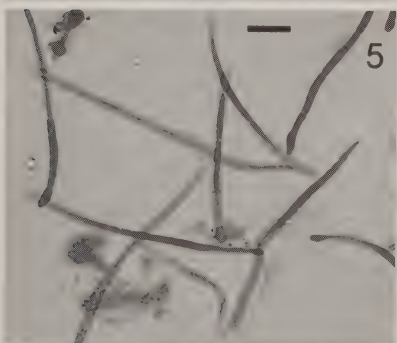
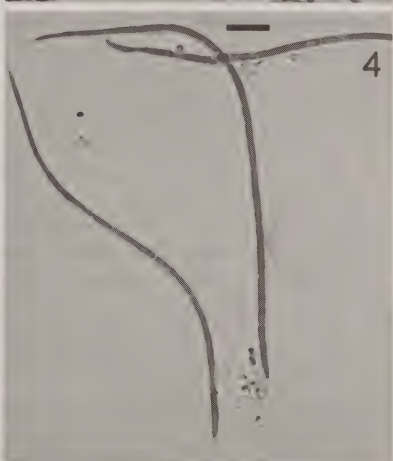
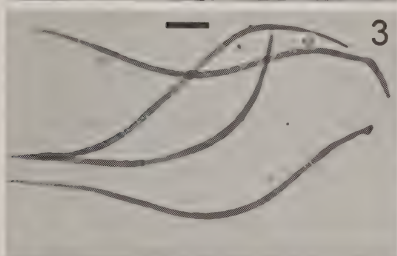
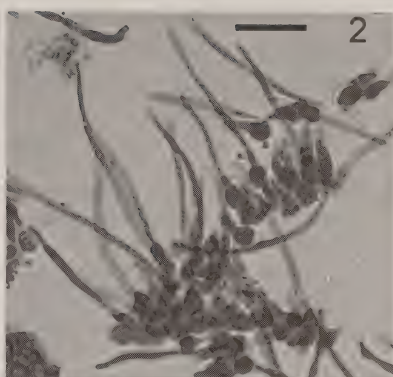
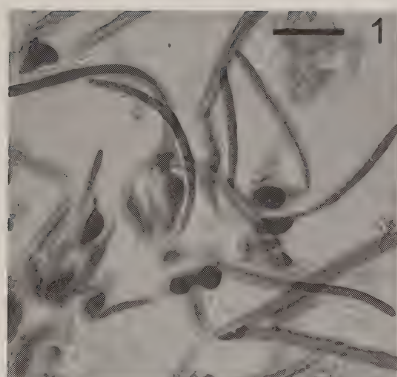
Among published DNA sequences available from Genbank, the most similar ITS sequence to *S. malagutii* was that of *S. lycopersici*. In contrast, the ITS sequence of *Septoria lycopersici* was more similar to that of *Septoria epambrosiae* D.F. Farr, *Septoria glycines* Hemmi, and *Septoria scabiosicola* Desm. (one transversion) and *Septoria lamiicola* Sacc. (one single nucleotide insertion) than it was to the ITS of *S. malagutii*. For both *S. lycopersici* and *S. malagutii*, the most similar teleomorphic ITS sequence in BLAST searches was *Mycosphaerella rubi* Roark (anamorph *Septoria rubi* Berk. & M.A. Curtis non Westend., nom. illeg.), with two transversions from *S. lycopersici* to *M. rubi* and four transversions from *S. malagutii* to *M. rubi*.

Among Genbank DNA sequences, the TEF-1 α sequence most similar to *S. malagutii* in BLAST searches (Altschul et al. 1997) was *Aureobasidium pullulans*, with 89% similarity (797/890 bp). There are no *Mycosphaerella* spp. or *Septoria* spp. sequences of the relevant region of TEF-1 α available for comparison. The TEF-1 α sequence most similar to *S. lycopersici* was *Cercospora piaropi* (AF146148) (teleomorph unknown). Only the first 449 bp of the TEF-1 α gene was available for comparison, for which the similarity was 323/399 (80%). There were no other *Septoria* sequences of TEF-1 α available for comparison.

While ITS and LSU rDNA sequences are available for a large number of *Septoria* and *Mycosphaerella* spp. (Crous et al. 2000, 2001; Verkley et al. 2004a, b), none of these include any of the *Septoria* species known to occur on *Lycopersicon esculentum* or *Solanum* species. Additional *Septoria* species on *Solanum* spp. include *Septoria alamoii* Toro, *S. dulcamarae* Desm., *S. melongenae* Lobik, *S. pseudoquinae* Pat., *S. solanicola* Ellis & Everh., *S. solanicola* Grove non Ellis & Everh., nom. illeg., *S. solanina* Speg., *S. solani-nigri* Scalia, and *S. solanophila* Speg. Of these, only *S. pseudoquinae* has been reported on *Solanum tuberosum* or other tuber-forming *Solanum* species. *Septoria malagutii* is distinguished from the other species of *Septoria* on *Solanum* spp. by its longer

Figs 1-10. 1, 3, 4, 7, 9 *Septoria malagutii*; 2, 5, 6, 8, 10 *Septoria lycopersici*. 1-2, conidiogenous cells (100x lens); 3-6, conidia (63x lens); 7-8, cultures, top view; 9-10, cultures, reverse. 1, 3, 4, – *S. malagutii*, specimen #2029; 2, 5 – *S. lycopersici*, BPI381513; 6 – *S. lycopersici*, BPI 522039; 7, 9 – *S. malagutii*, CBS 106.80; 8, 10 – *S. lycopersici*, CBS 354.49.

Bar 10 μ m.



conidia. Species of *Septoria* on *Lycopersicon esculentum* include *S. lycopersici* var. *lycopersici*, *S. lycopersici* var. *europaea* Briosi & Cavara, *S. lycopersici* var. *microspora* Dominik, *S. dulcamarae*, and *S. tomates* Speng.

Taxonomy

Septoria malagutii Ciccari. & Boerema ex E.T. Cline, sp. nov.

MYCOBANK MB 510075

[*Septoria lycopersici* var. *malagutii* Ciccari. & Boerema in Pignionica et al. 1978. La septoriosi della patata. *Phytopathologia Mediterranea* 17 (2): 87-88.] nom. inval.; type not explicitly designated (Art. 37.1, Art. 37.N1).

Maculae distinctae, amphigenae, circulares, 1-4 mm diam. raro 2 × 4 mm, in epiphylllo sepiaceae, laeves vel. circinatae, margine elevatulo cinctas, in hypophylo plus pallidae, laeves. Conidiomatae pycnidiae epiphyllae, plerumque in medio macularum solitariae vel paucae, prominulae, <100 µm diam., (aperta non vidi). Pycnidiae in agaris immaturae, 45-70 µm diam., brunneae vel. atrae, 3-5 µm, parietibus tenuibus, 3-5 µm, textura angularis faciens. Conidiophora absentia. Cellulae conidiogenae ampulliformes vel lageniformes, raro doliformes, discretas, determinatae, hyalinae, 7.4 ± 0.2 (4-11) µm × 3.57 ± 0.12 (2-8) µm. Conidia holoblastica, hyalina, filiformia, parum vel fortiter curvata, interdum recta aut sigmoidea, fortiter acuta ad utrinque apices, interdum parum rotundata ad basim, conidia affixa apice rotundato, 90.6 ± 3.4 (53 - 132) µm × 1.91 ± 0.03 (1.4 - 2.2) µm, (2-) 4-6 (-7) septata, non constricta. Coloniae (ex CBS 106.80) in agar "potato-dextrose," post 15 dies 31 mm diam., mycelio aereo dealbato velatae et in agar cinereo-purpureo vel pallenti, floccosae, reverso brunneo-vinaceo, raro livido-rubro. Temperatura crescentia optima 21° C, maxima <28° C.

Holotypus: Specimen 2029, Herbarium Plantenziektenkundige Dienst Wageningen.

Etyymology: in honor of Dr. G. Malaguti, a distinguished phytopathologist from Venezuela.

Leaf lesions amphigenous, circular, 1-4 mm diam or rarely elongate, 2 × 4 mm, delimited at one side by vein, solitary, occasionally confluent, scattered, epiphyllous spots sepia, sometimes grayish sepia toward center, smooth with faint concentric ridges, margin well-defined, slightly raised, hypophyllous spots slightly paler, smooth. **Conidiomata** pycnidial, epigenous, solitary, scattered, one to three per lesion, immersed, visible as a slightly raised bump, less than 100 µm diam, ostiole not seen, immature pycnidia developing in culture, 45-70 µm diam, brown to black, thin-walled, 3-5 µm wide, of textura angularis in cross section. Conidiophores absent. **Conidiogenous cells** ampulliform to lageniform, rarely doliiform, discrete, determinate, hyaline, 7.4 ± 0.2 (4-11) µm long × 3.57 ± 0.12 (2-8) µm wide, formed from inner surface of conidiomatal wall. **Conidia** holoblastic, hyaline, filiform, slightly to strongly curved, occasionally straight or sigmoid, sharply pointed at both ends, sometimes slightly rounded at base, apex rounded when conidia still attached, 90.6 ± 3.4 (53-132) µm long × 1.91 ± 0.03 (1.4-2.2) µm wide, (2-) 4-6 (-7) septate not constricted at septa. **Cultural characteristics** based on strain CBS 106.80 on

PDA after 15 days at 23° C, with supplemental fluorescent light, colony 31 mm diam, aerial mycelium white, underlying color purplish-grey to pale purplish grey, surface floccose, slightly raised, margin even to bayed, fawn to salmon, reverse faintly ringed, brown-vinaceous, one sector livid red.

Specimens examined—#2029, labeled “*Septoria lycopersici* Speg. var. *malagutii* Ciccarone et Boerema,” PERU: Dist. Yarowilca near Chavinillo, Lliclatambo, alt. 3700 m., on *Solanum tuberosum*, coll. by H. Torres, Oct. 1979, received from Turkensteen, determined by W.M. Loerakker, holotype. Herbarium Plantenziektenkundige Dienst Wageningen.

Culture examined—CBS 106.80 (PD 75/912) PERU: Dep. Junin, Huasahuasi, alt. 3000 m, on leaves of *Solanum* sp. in series *tuberosa*, coll. L.J. Turkensteen, 1975, identified & deposited by G.H. Boerema, Jan. 1980.

Habitat—on living leaves of *Solanum tuberosum* and other tuber-forming *Solanum* spp. in series *tuberosa* in the Andes mountains of South America at elevations above 3000 m in Peru and Venezuela. Distinguished from *Septoria lycopersici* var. *lycopersici* by its shorter, narrower conidiogenous cells, longer, narrower, frequently curved or sigmoid conidia, growth preference for lower temperatures, production of a vinaceous pigment in culture and inability to form fertile pycnidia on living leaves of *Lycopersicon esculentum*.

Notes—According to Piglioni et al. (1978), isotypes (in Italian, described as “co-tipi”) were deposited at il Centro de Investigaciones Agronomicas, Maracay, Venezuela; l’Istituto di Patologia Vegetale, Universita di Bari, Italy, and the Plantenziektenkundige Dienst, Wageningen, The Netherlands. No specimen number or other supporting detail was given. This does not constitute an adequate designation of the type specimen (Greuter et al. 2000, Art. 37.1, Note 1), therefore “*Septoria lycopersici* var. *malagutii*” must be regarded as an invalid name. Material from the original collection was not available from the three herbaria listed by Piglioni et al. (1978). We have designated as holotype specimen #2029 from the Herbarium Plantenziektenkundige Dienst Wageningen labelled “*Septoria lycopersici* var. *malagutii*”, collected Oct. 1979, one year after Ciccarone & Boerema published the invalid description of “*Septoria lycopersici* var. *malagutii*.”

Acknowledgments

We thank Cindy Park and Aimee Hyten for their generous assistance in the laboratory, and Karin Rosendahl-Peters of the Plantenziektenkundige Dienst Wageningen for kindly providing the specimen of “*S. lycopersici* var. *malagutii*”. We are grateful to Christian Feuillet for review of the Latin description and to Mikhail Sogonov for providing the *Taxonomica* program for image analysis. The comments of Scott Redlin and Mary Palm as pre-submission reviewers are greatly appreciated.

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Description and phylogenetic placement of *Beauveria malawiensis* sp. nov. (Clavicipitaceae, Hypocreales)

STEPHEN A. REHNER¹, MARILENA AQUINO DE MURO²
& JOSEPH F. BISCHOFF^{1,3}

rehners@ba.ars.usda.gov

¹Insect Biocontrol Laboratory, USDA-ARS
Beltsville, Maryland 20705 U.S.A.

²CABI Bioscience
Bakeham Lane, Egham, TW20 9TY, U.K.

³National Center for Biotechnology Information, National Institutes of Health
Bethesda, Maryland 20894 U.S.A.

Abstract—A new entomopathogenic species, *Beauveria malawiensis*, is described. *Beauveria malawiensis* was isolated from a cadaver of *Phoracantha semipunctata* (Coleoptera: Cerambycidae) collected in Zomba, Malawi. Morphologically, *B. malawiensis* is distinguished by its pink colony color, the terminal and intercalary clusters of inflated conidiophores that each gives rise to multiple rachiform conidiogenous cells, and holoblastic cylindrical conidia. Phylogenetic analysis of nuclear ribosomal internal transcribed spacer and translation elongation factor-1 alpha sequences place *B. malawiensis* apart from other species in the genus that also produce cylindrical conidia, supporting its proposed species status.

Key words—*Cordyceps*, fungal entomopathogen, new species, taxonomy

Introduction

Beauveria Vuill. is a genus of ecologically prominent fungal entomopathogens. Due to widespread interest in this genus for biological control of pest insects, numerous isolates of *Beauveria* have been deposited in fungal culture collections throughout the world. Evaluation of these germplasm resources, however, has been hindered by difficulties in applying existing morphological species concepts and the lack of a contemporary taxonomic revision for the genus (MacLeod 1954, de Hoog 1972).

Recent phylogenetic analyses of *Beauveria* inferred from nuclear ribosomal internal transcribed spacers (ITS) and elongation factor-1alpha (EF-1 α) resolved

six major clades (A-F), each of which includes one or more recognized species (Rehner & Buckley 2005). Subsequently, our laboratory has screened over 800 *Beauveria* isolates by analyses of nucleotide variation in the 5' intron-rich region of EF-1 α (Rehner unpublished). Using this diagnostic phylotyping approach, all strains were assigned to the aforementioned Clades A-F. These results affirm the use of nucleotide data for rapid provisional species identification in *Beauveria*. Additionally, because the majority of Asian, European and South American isolates screened were assigned to these previously recognized clades, it is likely that the principal lines of diversity in *Beauveria* that commonly occur in these regions have already been discerned.

Table 1. Cultures of taxa included in ITS and EF-1 α phylogenetic analyses and their corresponding GenBank accession numbers.

Taxa	Culture Number ¹	ITS Genbank #	EF1- α Genbank #
<i>Beauveria bassiana</i>	ARSEF 751	AY532045	AY531954
<i>Beauveria bassiana</i>	ARSEF 1040	AY531972	AY531881
<i>Beauveria bassiana</i>	ARSEF 300	AY532015	AY531924
<i>Beauveria bassiana</i>	ARSEF 1811	AY531992	AY531901
<i>Beauveria bassiana</i>	ARSEF 1478	AY531981	AY531890
<i>Beauveria bassiana</i>	ARSEF 1848	AY531995	AY531904
<i>Beauveria brongniartii</i>	ARSEF 4362	AY532025	AY531934
<i>Beauveria brongniartii</i> *	JE 276	DQ376245	DQ376244
<i>Beauveria</i> sp.	ARSEF 3220	AY532020	AY531928
<i>Beauveria</i> sp.	ARSEF 4933	AY532029	AY531938
<i>Beauveria caledonica</i>	ARSEF 2567	AY532006	AY531915
<i>Beauveria amorpha</i>	ARSEF 2251	AY532003	AY531912
<i>Beauveria vermiconia</i>	ARSEF 2922	AY532012	AY531920
<i>Beauveria</i> sp.	ARSEF 1685	AY531990	AY531899
<i>Cordyceps</i> cf. <i>staphylinidicola</i>	ARSEF 7044	AY532040	AY531949
<i>Beauveria</i> sp.	ARSEF 1969	AY531998	AY531907
<i>Beauveria</i> sp.	ARSEF 2641	AY532008	AY531917
<i>Cordyceps</i> cf. <i>scarabaeicola</i>	EFCC 2533	AY532058	AY531967
<i>Beauveria malawiensis</i> * sp. nov.	IMI 228343	DQ376247	DQ376246

*Sequences determined in this study. Other sequences were obtained from GenBank.
¹Accession codes of isolates sequenced: ARSEF (ARS Entomopathogenic Fungus Collection, Ithaca, NY, U.S.A.); EFCC (Entomopathogenic Fungus Culture Collection, Kangwon National University, Korea); IMI (CABI Bioscience UK Centre, Egham, England); JE (Jürgen Enkerli, Swiss Federal Research Station for Agroecology and Agriculture, Zurich, Switzerland).

Past investigations of *Beauveria* have largely omitted material from Africa, and isolates from this continent are poorly represented in most culture collections. We recently examined a *Beauveria* isolate from Malawi, IMI 228343, infecting the *Eucalyptus* borer *Phoracantha semipunctata*. This isolate possesses unusual cultural and morphological characteristics and we have determined through phylogenetic analysis that it is uniquely derived within *Beauveria*. Based on these results we conclude that IMI 228343 represents a new species, which is described herein.

Materials and methods

Fungal Material: The isolate of *Beauveria malawiensis* (IMI 228343) was collected May 4, 1978 by R.G. Pawsey in Zomba, Malawi from the *Eucalyptus* borer, *Phoracantha semipunctata*. Routine growth of IMI 228343 was on quarter-strength Sabouraud's dextrose + yeast agar (SDY: 1% w/v peptone, 4% w/v dextrose, 0.2% yeast, 1.5% w/v agar; Goettel & Inglis 1997). The culture was maintained at approximately 23 °C under irregular light/dark fluorescent illumination in the laboratory. All cultural and morphological features described here were obtained from an ex-type culture of IMI 228343.

Cultural Studies: IMI 228343 was grown on quarter-strength SDY (SDY/4), Difco™ potato dextrose agar (PDA) (J.T. Baker Chemical Co., Phillipsburg, New Jersey, U.S.A.) and Difco™ corn meal agar (CMA). Culture plates were maintained at 23 °C in a diurnal light/dark cycle and the growth rate and morphology of the colonies was observed over a three-week period. Terminology for colony color is from Kornerup & Wanscher (1978). Hyphae, conidiophores, conidiogenous cells and conidia were observed by light microscopy. Measurements of conidiogenous cells and conidia were determined at two and three days following transfer to fresh agar plates and are based on the ranges of at least 20 independent measurements.

DNA extraction, PCR, Sequencing and Analysis: Liquid culture and DNA extraction were performed according to Rehner & Buckley (2005). ITS and EF-1 α of IMI 228343 and *B. brongniartii* JE 276 were amplified by PCR and sequenced as described by Rehner and Buckley (2005). Culture voucher and Genbank accession numbers for these and additional taxa included in the phylogenetic analysis are provided in Table 1.

Editing and alignment of ITS and EF-1 α sequences were performed as described by Rehner & Buckley (2005) and were combined within a single Nexus file. Bayesian inference and Maximum Parsimony bootstrapping were conducted on an alignment including all sequences listed in Table 1. Initial analyses of the data sets were conducted to determine whether the data could be combined (not shown). Clades with 70% or greater bootstrap (BP) and 95% or greater posterior probability (PP) support were considered significantly supported by the data (Mason-Gamer & Kellog 1996, Reeb et al. 2004). No conflict was detected under these criteria and the two data sets were combined. The combined ITS and EF-1 α sequences were analyzed as separate partitions by Bayesian inference with the program MrBayes 3.0b4 (Huelsenbeck 2000, Huelsenbeck et al. 2001). Bayesian analysis was run with four chains (three cold, one heated) and the current tree was saved to a file every 100 generations for a total of 2,000,000 generations.

The analysis was repeated four times. For each analysis, the initial 5000 trees ("burn-in") were discarded and the remaining 15,000 trees (post "burn-in") were combined into a single tree file and a 50% majority-rule consensus tree of the remaining trees was obtained with PAUP* v.4.0b10 (Swofford 2002). Posterior probabilities for branches receiving $\geq 95\%$ support are reported above the respective branches on the single best tree from the Bayesian analysis (Fig. 7). As a second measure of branch support, ten replicates and a thousand pseudoreplicates of non-parametric bootstrapping were performed under Maximum Parsimony with PAUP* using the heuristic search strategy and the branch-swapping algorithm set to tree-bisection-reconnection. The bootstrap values for branches supported in $\geq 70\%$ of pseudoreplicates are listed below branches in Fig. 7. Sequences of *Cordyceps* cf. *scarabaeicola* EFCC 2533 were used to root the analyses. Rehner & Buckley (2005) showed that this isolate is either a basal member or sister to the *Beauveria* lineage.

Taxonomic description

Beauveria malawiensis S.A. Rehner & Aquino de Muro, sp. nov.

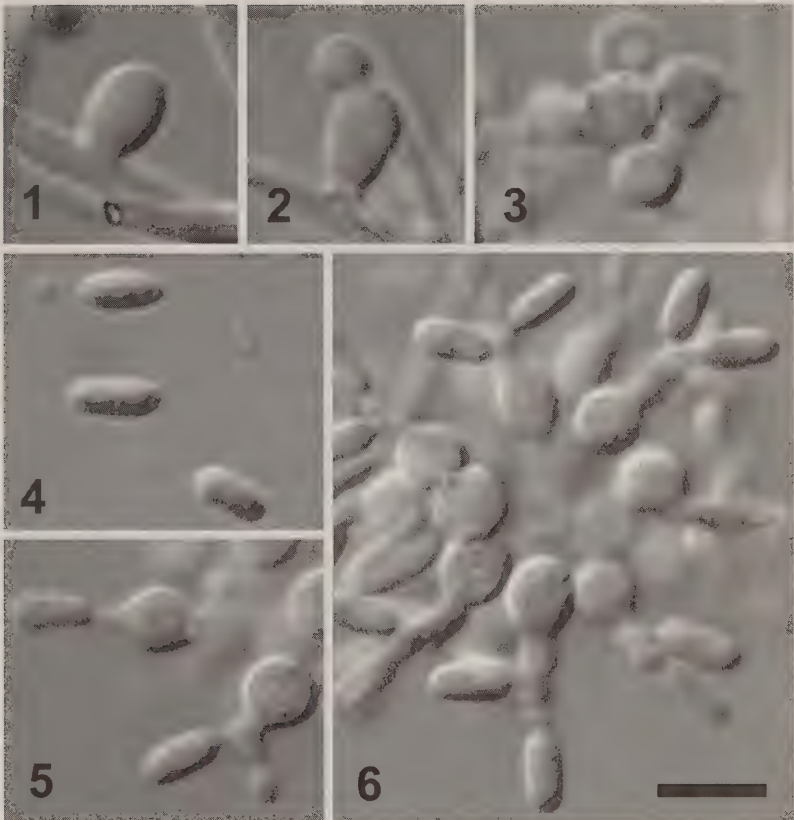
MYCOBANK #: MB 510468

(Figs. 1-6)

Etymology: *malawiensis*, for the country of origin, Malawi.

Colonia in agaro cultivata 32.5 mm diametro post 10 dies 23 °C flocci modo, initio alba et postea pallido-rosacea, dorso albo, postea pallido-rosaceo quoque. Hyphae saeptis praeditae, hyalinae, laeves, 1.6-2.4 µm latae. Conidiophorae hyalinae, globosae, 4.3-8.0 µm latae, simplices. Conidigenae cellulae hyalinae, base inflatae, globosae 3.7-8.0 x 1.3-1.9 µm. Conidia holoblastica, hyalina, simplicia, cylindrica, unicellularia, 3.7-1.9 x 1.3-4.5 µm, laevia. Typus, Zombae, Malawi, 1978, legit R.G. Pawsey, IMI 228343.

Colonies on SDY/4 white, becoming light pink (7A2; Kornerup & Wanscher 1978) in older portions of the colony, aerial mycelium dense and cottony, colony attaining a diameter of 32.5 mm after 10 days at 23 °C, heavy accumulation of conidia over older portions of colony which also become light pink (7A2; Kornerup & Wanscher 1978) en masse, the reverse light pink (7A2; Kornerup & Wanscher 1978) and faintly zonate, the margin white. On PDA, the colony white to pale pink (7A2; Kornerup & Wanscher 1978) and slightly zonate, the aerial mycelium dense and appressed to the agar surface, attaining a diameter of 34 mm after 10 days at 23 °C, powdery accumulation of conidia over older portions of colony light pink en masse, reverse subtly zonate and alternating between white and light pink, the margin white. On CMA, the colony not pigmented, mycelium growing as a thin submerged layer that is nearly transparent, surface with scattered areas of conidia production, attaining a diameter of 32 mm after 10 days at 23 °C, reverse white. Odor indistinct. Mycelium of septate, branched, hyaline, smooth, 1.6-2.4 µm wide hyphae. Conidiophores (Fig. 1-3) originate laterally and less commonly terminally from hyphae, becoming globose 4.3-8.0 µm wide, giving rise to multiple conidiogenous cells. Conidiogenous cells with globose to obpyriform base, 4.2-6.6 µm wide, with a holoblastic geniculate apex.



Figs. 1–6. Microscopical features of *B. malawiensis* from the ex-type BPI 871188. 1. Conidiophore initial arising laterally from hypha. 2. Conidiogenous cell originating from conidiophore. 3. Conidiogenous cells produced from a single conidiophore in a two-day-old culture. 4. Conidia. 5. Conidia originating from conidiogenous cells. 6. Conidiogenous cells with attached conidia projecting outward from a cluster of conidiophores in a three-day-old culture. Bar = 5 μ m.

Conidia (Fig.4) holoblastic, hyaline, simple, eguttulate or with 1–2 guttules, cylindrical, smooth, aseptate $3.7\text{--}4.5 \times 1.3\text{--}1.9 \mu\text{m}$, en masse pale pink. No chlamydospores were observed on any medium after 21 days. Teleomorph not observed. Holotype: *Beauveria malawiensis*, isolated from *Phoracantha semipunctata* (Coleoptera: Cerambycidae), Zomba, Malawi, holotype, IMI 228343, a dried agar culture. A dried ex-type agar culture has been deposited as BPI 871188.

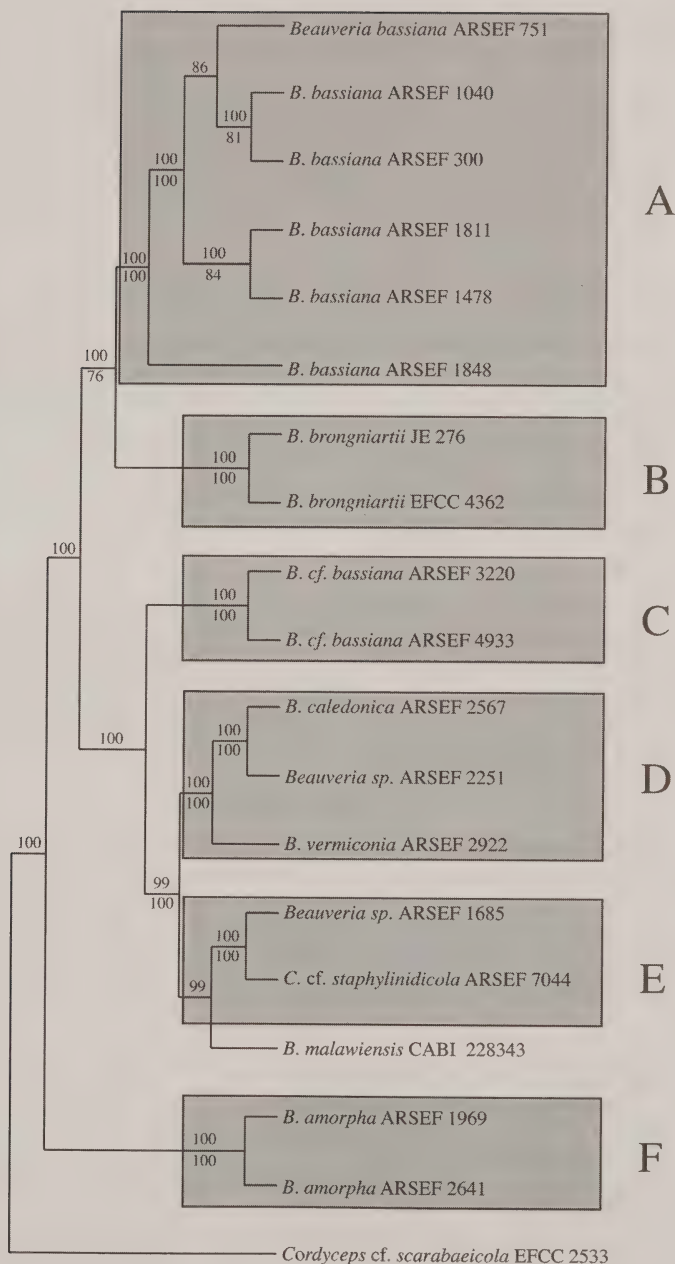
In agar culture *Beauveria malawiensis* is distinguished by the progressive light pink pigmentation of the hyphae and conidia in mass when grown on SDY

and PDA media. Most species of *Beauveria* are white to buff on solid media although yellow and pink colony pigmentation may develop in some cultures of *B. bassiana* (Bals.-Criv.) Vuill. and *B. brongniartii* (Sacc.) Petch (de Hoog 1972). The conidia of *B. amorpha* (Höhn.) Samson & H.C. Evans are yellow in mass (Samson & Evans 1982). Although the pink pigmentation of *B. malawiensis* did not diffuse into the agar media during the course of our observations, this isolate did produce a deep red water-soluble pigment when grown in SDY broth. Other species of *Beauveria* (e.g., *B. bassiana*, *B. brongniartii*, *B. cf. bassiana* “clade C”) also produce extracellular red pigments in either or both agar and liquid SDY, although this ability is often inconsistent among isolates and even among subcultures of individual isolates (Basyouni et al. 1968, Rehner unpub.). In *B. bassiana*, this red soluble pigment has been identified as dibenziquinone (3, 3', 6, 6'-tetrahydroxy-5, 5'-dimethyl-2, 2'-bi-benziquinone), which is also known as oosporein (MacLeod 1954, Basyouni et al. 1966, Eyal et al. 1994, Strasser et al. 2000, Vey et al. 2001). It is not known if the soluble red pigment produced by *B. malawiensis* is also oosporein nor is it known whether the pigment accumulating in the walls of mycelia and conidia of *B. malawiensis* is the same as that produced in liquid culture. The taxonomic and functional significance of these and other metabolites produced by *Beauveria* species are part of ongoing investigations (MAdeM, unpublished).

Microscopically, *B. malawiensis* is characterized by cylindrical conidia, globose conidiophores and globose conidiogenous cells. Two other species of *Beauveria* also produce cylindrical conidia: the South American species *B. amorpha* (Samson & Evans 1982) and the European species *B. caledonica* Bissett & Widden (Bissett & Widden 1988). The size of *B. malawiensis* conidia, 3.7–4.5 x 1.3–1.9 µm, is intermediate but overlap the conidia of *B. amorpha*, which are 5–6 x 1.5–1.7 µm, and slightly larger than conidia of *B. caledonica*, which are 2.6–4.2 x 1.6–2.3 µm. The conidia of *B. malawiensis* tend to be straight in profile as opposed to the slight curvature described for conidia of *B. amorpha* and *B. caledonica*.

Beauveria malawiensis also differs from *B. amorpha* and *B. caledonica* by its distinctive globose conidiophores, which are 4.3–8.0 µm wide and give rise to multiple, sessile, globose conidiogenous cells. Although conidiophores of *B. amorpha* were not mentioned in the emended description of this species by Samson & Evans (1982), they are illustrated in their Fig. 7F–G and the shape is depicted as short cylindrical to subglobose. In *B. caledonica* the conidiophores

Fig. 7. Best tree from Bayesian likelihood analysis (-lnL 6159.96) with Bayesian posterior probabilities and bootstrap values labeled above and below branches, respectively. Labeling of clades A–F as described in Rehner & Buckley (2005). This analysis illustrates the phylogenetic placement of *B. malawiensis* as the sister to Clade E.



are subclavate to short-cylindrical, 2.4–4.8 μm wide and up to 8 μm long. In both *B. amorphia* and *B. caledonica*, conidiogenous cells are also borne laterally from hyphae, whereas sessile conidiogenous cells were rarely observed in *B. malawiensis*. The conidiogenous cells of both *B. amorphia* and *B. caledonica* are smaller and differ in shape from *B. malawiensis*, which are globose and 4.2–6.6 μm wide. The conidiogenous cells of *B. amorphia* are globose to subglobose and 2–4 μm wide; for *B. caledonica* the conidiogenous cells are ellipsoidal and 2.6–4.2 μm wide.

In the Bayesian analysis of ITS and EF-1 α sequences (Fig. 7), *B. malawiensis* is positioned as the sister to clade E, a lineage identified by Rehner & Buckley (2005). Clade E consists of a *Cordyceps* isolate, ARSEF 7044, which was accessioned under the name *C. staphylinidicola* Kobayasi & Shimazu, and an unidentified isolate of *Beauveria* (ARSEF 1685). Both isolates have ellipsoidal conidia, 3.0–4.4 $\times$ 2.5–3.3 μm , and originate from northeast Asia. *Beauveria malawiensis* is phylogenetically distinct from other *Beauveria* species that produce cylindrical conidia, i.e., *Beauveria amorphia* (Clade F), and *B. caledonica* (Clade D) (Fig. 7). Thus, the phylogenetic data support the recognition of *B. malawiensis* as a distinct species.

The discovery of *B. malawiensis*, which was deposited in the IMI culture collection over twenty years ago, illustrates the potential for encountering novel fungi within existing germplasm resources. Furthermore, it is interesting to note that isolates from Africa are poorly represented in most culture collections. The discovery of this new species suggests the biodiversity of African *Beauveria* warrants further investigation.

Acknowledgements

We thank Jürgen Enkerli for providing the isolate of *B. brongniartii* and Ellen Buckley for assistance with sequencing. M. Aquino de Muro thanks OECD for fellowship support. The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the United States Department of Agriculture or the Agricultural Research Service of any product or service to the exclusion of others that may be suitable.

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***Coprinus doverii* sp. nov., a unique new species of subsection *Setulosi* from central and southern Europe**

LÁSZLÓ NAGY*

* *cortinarius2000@yahoo.co.uk*

Department of Microbiology, University of Szeged

P.O.Box 533.H-6701, Szeged, Hungary

Abstract – A new species of *Coprinus*, *Coprinus doverii*, is described based on material collected in Hungary and Italy. This new species is a very peculiar member of subsection *Setulosi* because of the mitriform spores with two large nodules at each side. The taxonomic position of the new species and possible relationships with other members of the genus *Coprinus* sensu lato are discussed.

Key words—*Agaricales*, *Coprinaceae*, taxonomy

Introduction

Species of the genus *Coprinus* are rather well investigated in northern and western Europe due to the extensive work of Kees Uljé. In eastern and southern Europe, however, no extensive revisions were carried out. Other genera of *Agaricales* often show a good number of species that are geographically restricted to mediterranean or continental regions of Europe. There is, indeed, considerable unknown diversity, especially in species of subsection *Setulosi*, of the genus *Coprinus* sensu lato (Nagy 2005, unpubl.). In this paper we present a peculiar new species found twice in Hungary and once in Italy.

Materials and methods

The macroscopical description was made on fresh material growing on dung samples that were incubated in a moist chamber. Drawings of microscopic details were made based on microphotographs of dried material rehydrated in 10% NH_4OH ; spore measurements are based at least on 20 samples from each collection. A notation like (20,2,1) after the word „spores” refers to the number of spores measured, the number of fruitbodies and the number of collections from which the spores were taken, respectively. Q_1 means the quotient of length divided by the breadth in face view, while Q_2 means the breadth in lateral view

being the denominator. Herbarium acronyms follow Holmgren & al. (1998). In this paper we follow a traditional concept of the genus *Coprinus* and not the one proposed by Redhead & al. (2001), because we feel it is premature to adopt at the moment and because unpublished phylogenetic results of the author fail to support that subdivision of coprinoid homobasidiomycetes in the family *Psathyrellaceae*. Collections have been deposited in the personal herbarium of the author, Francesco Doveri, L and BP.

Taxonomic description

Coprinus doverii L. Nagy sp. nov.

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FIGURE 1.

Pileus primo late ellipsoideus vel obtuse conicus, usque ad 1.5 x 2 mm, deinde hemisphaericus vel campanulatus, demum applanatus, usque ad 5 (7) mm diam., in primordiis olivaceo-fuscus, deinde concolor at ad marginem pallidior, demum ochraceus, oleagino suffusus, radialiter striatus, deinde fissuratus, brevipilosus. Lamellae stipitem non attinentes, densae, valde ventricosae, usque ad 0.3 mm altae, ex albo nigricantes. Stipes 0.2-0.6 x 10-25 mm, procerus, omnino pilosus, immutabiliter albidus. Sporae (20,2,1) 7-8.3 x 5-5.7 x 3.8-4.1 μ m, in adverso visu mitriformes ad subhexangulae, rotunde quadrinodosae, superne angustiores, aliquando ad apicem rotundatae, a latere cylindratae ad subamygdaliformes, fuscobadiae, valde excentrico, 1.7-2 μ m lato, poro germinativo praeditae. Basidia tetraspora, bimorpha, 17-25 x 6-7 μ m. Cheilocystidia valde dispersa, plus minusve globosa, 10-14 μ m diam. Pleurocystidia absentia. Pileocystidia 35-65 x 6-13 μ m, lageniformia, rare incrustata, ad acutum apicem contracto, vel perraro cylindrato collo praedita. Caulocystidia pileocystidiis similia, in forma magis mutabilia, ad basim latioria, usque ad 16 μ m diam. Sclerocystidia absentia. Velum in pileo oculis non subiectum, ex 11-25 μ m latis, globosis, saepe refringentibus crystallis conspersis partibus compositum. Pileipellis in hymenidermae modum. Fibulae praesentes.

Holotype: HUNGARY, NEAR KECSKEMÉT: Nyír, on deer dung in xerothermous *Convallario-Quercetum roboris* association (both found in the field and incubated in moist chambers), approx 50 fruitbodies, 10.9.2006., leg.: L. Nagy & Zs. Gorliczai, herb.: BP.

Etymology: named after Francesco Doveri, who collected this fungus in Italy and made several important contributions on various coprophilous fungi.

Description

Pileus up to 1.5 x 2 mm when still closed, mainly broadly elliptical to obtusely conical, becoming hemispherical to campanulate, flattened when fully mature, up to 5 (7) mm diam., dark olive-brown in primordial stages, with brown olive-brown centre and pale ochraceous margin later, uniformly dark ochraceous with faint olive tint when old; surface strongly translucently striate when young, becoming radially sulcate, shortly pilose. **Veil** macroscopically not observable, see below under microscopical features. **Lamellae** free, crowded, strongly ventricose, up to 0.3 mm broad, at first white, then blackish. **Stipe** 0.2-0.6 x 10-25 mm, slender, whitish also when old, pilose all over.

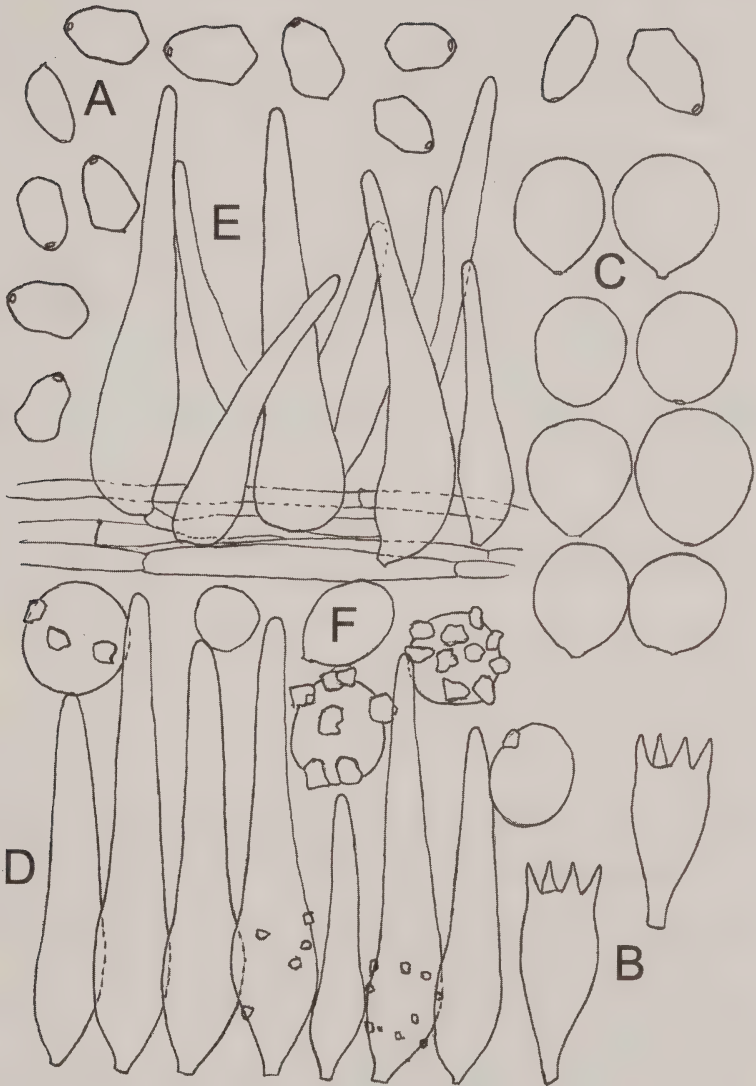


Figure 1. *Coprinus doverii* (Holotype) A: Spores, B: Basidia, C: Cheilocystidia, D: Pileocystidia, E: Caulocystidia, F: Velar spherocysts. (Magnification 2500x for spores, 2000x for other features)

Basidiospores (65,4,3) 6.2–8.3 x 4.5–5.8 x 3.8–4.1 μm , on average 7.68 x 5.32 μm , $Q_1 = 1.36$ –1.54, $Q_2 = 1.8$ –2.1; in frontal view mitriform to subhexagonal with four, more or less rounded nodules with an apical half being narrower, sometimes with rounded apex, in lateral view cylindrical to subamygdaliform, medium dark red–brown, with strongly eccentric, 1.7–2 μm wide germ pore; **Basidia** 4-spored, dimorphic, 17–25 x 6–7 μm ; **Cheilocystidia** very sparse, globose to balloon-shaped, 10–14 μm diam.; **Pleurocystidia** absent; **Pileocystidia** short, lageniform with tapering, exceptionally cylindrical neck and narrow, more or less acute tip, rarely somewhat encrusted, 35–65 x 6–13 μm ; **Caulocystidia** similar to pileocystidia, more variable in shape, mainly broader in the basal part, up to 16 μm ; **Sclerocystidia** absent, but some pileocystidia with slightly thickened walls are observable; **Veil** on pileus made up of 11–25 μm wide, globose elements, often covered with coarse, strongly refringent crystals; **Pileipellis** is hymeniderm; Clamp – connections present.

Habitat and distribution: Two of the collections found were growing on deer dung, in the third case, it was impossible to identify the animal from which the dung originated. Two collections were obtained by incubating the dung sample in moist chambers. The hungarian collections were made in xerothermous *Convallario – Quercetum roboris* association and in a swamp – forest (*Fraxino pannonicae – Alnetum*). To date this species is only known from Hungary and Italy.

COLLECTIONS EXAMINED: HUNGARY, NEAR KECSKEMÉT: Nyír, 10.9.2006., leg.: L. Nagy & Zs. Gorliczai, herb.: BP (*Holotypus*); TÖSERDŐ, 30 km E of Kecskemét, 20.10.2005., L. Nagy & Zs. Gorliczai, herb.: L.N.; ITALY: LIVORNO, F. Doveri, 16.04.2004., herb. Doveri 016.04 and L.

Discussion

This species is easily recognizable by the nodulose spores, coprophilous habitat and the presence of pileo- and caulocystidia. With the exception of *C. angulatus* Peck, a carbonicolus species, other taxa with nodulose spores can be found only in other sections, like *C. calosporus* Bas & Uljé in subsection *Lanatuli* and *C. iocularis* Uljé in subsection *Nivei*. The spores of *C. iocularis* are extremely similar to that of *C. doverii*, their separation is, however, straightforward, because *C. iocularis* has no pileo- and caulocystidia, but abundant granulose veil, central germ pore, habitat on lawns, and utriform cheilocystidia.

Within subsection *Setulosi* our species seems to possess an isolated position. In Uljé's (1991, 2005) practical key our species would key out near *C. angulatus* and *C. marculentus* Britzelm. The former has similar spores, but they are larger, has a carbonicolus habitat, much larger fruitbodies, and pleurocystidia. *C. marculentus* can grow on dung, but it is generally larger, has hexagonal spores,

which are, in addition larger and the neck of its pileocystidia is cylindrical with enlarged apex. Based on size of the spores, size and shape of the pileocystidia, and globose cheilocystidia, one could assume a relationship with the *brevisetulosus* group (*C. pellucidus* P. Karst., *C. brevisetulosus* Arnolds) but these species lack any veil, have central germ pore, and the spores have a typical pale colour.

In all our collections, the pileocystidia showed both tapering and cylindrical neck. It is very difficult to assess the taxonomic importance of this otherwise intraspecifically constant character. Uljé (1991, 2005), although informally, used it to divide *Setulosi* species with elliptical spores into two larger groups. However, there are obviously very closely related species pairs combining both types of pileocystidia neck. Such an example is *C. callinus* M.Lange. & A. H. Sm. and *C. sclerocystidiosus* M.Lange. & A. H. Sm., the former having pileocystidia with tapering neck, somewhat less abundant sclerocystidia and insignificantly smaller spores. Of these differences, only the shape of the neck of pileocystidia seems to be a constant character. Our species is the first example having both types of pileocystidia neck within one species and even within a single fruitbody.

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Two new species of *Kirschsteiniothelia* from Taiwan

CHI YU CHEN, CHIH LI WANG & JENN WEN HUANG*

chiyu86@dragon.nchu.edu.tw chihli@fthes-tari.gov.tw

*jwhuang@dragon.nchu.edu.tw

Department of Plant Pathology, National Chung Hsing University
250 Kuo Kuang Rd, Taichung 402, Taiwan

Abstract—The generic concept of *Kirschsteiniothelia* is clarified based on the characteristics of the type species, *K. aethiops*. Two new species, *K. reticulata* and *K. smilacis*, are described and illustrated from Taiwan. They are more closely related to the type species than other species in *Kirschsteiniothelia* by having conical ascomata, obclavate asci, and ascospores with a mucilaginous sheath.

Key words—loculoascomycete, taxonomy

Introduction

The genus name *Kirschsteiniothelia* was introduced by Hawksworth (1985) for a group of species previously included in the genus *Microthelia* Körber and similar to *Microthelia incrustans* (Ellis & Everh.) Corlett & S. Hughes. *Kirschsteiniothelia* is based on the type species *K. aethiops* (Berk. & M.A. Curtis) D. Hawks. of which Hawksworth (1985) considered *M. incrustans* to be a synonym. Because the basionym *Sphaeria aethiops* Berk. & M.A. Curtis 1876 predates the basionym *Amphiosphaeria incrustans* Ellis & Everh. 1890, he recognized this species as *K. aethiops*. Further species were subsequently added to this genus by Barr (1993), Hyde (1997), Shearer (1993), and Wang et al. (2004), largely conforming to the genus definition provided by Hawksworth (1985). At present 17 species are included in *Kirschsteiniothelia*.

Chen & Hsieh (2004a) reexamined the type specimen of *Sphaeria aethiops*, and concluded that *S. aethiops* and *M. incrustans* are actually two different species. In *S. aethiops* the ascomata are conical, the asci are generally obclavate, and the ascospores have a mucilaginous sheath, whereas in *M. incrustans* the ascomata are subglobose, the asci are subcylindrical, and the ascospores lack a sheath. As a result, the species concept of *K. aethiops* should be altered to coincide with the

*corresponding author

features of its basionym. The circumscription of the genus *Kirschsteiniothelia* based on the restricted concept of *K. aethiops* is narrower than currently recognized. Many species in *Kirschsteiniothelia* were described using the broad generic concept. Many of these species are closer to *Microthelia incrustans* than to the generic type *K. aethiops*. Judging from the significant differences between *K. aethiops* and *M. incrustans*, species similar to *M. incrustans* should be assigned to a genus other than *Kirschsteiniothelia*.

In a continuing survey of ascomycetes in Taiwan, two fungi were found sharing the following major characteristics with *K. aethiops*: conical ascomata, obclavate asci, 1-septate brown ascospores with surface ornamentation and surrounding sheath. They are best accommodated in *Kirschsteiniothelia*, and the ascospore morphology distinguishes both fungi from *K. aethiops*. Two new species, *K. reticulata* and *K. smilacis*, are accordingly proposed. Combined with *K. aethiops*, these species constitute a well-defined group within *Kirschsteiniothelia*, distinguishable from other species of this genus. *Kirschsteiniothelia* species with conical ascomata, i.e. *K. aethiops* and the two newly established species, *K. reticulata* and *K. smilacis*, may be confused with species in the genus *Astrosphaeriella* Syd. & P. Syd. (Chen & Hsieh 2004b Hyde & Fröhlich 1998). However, the ascomata in these three *Kirschsteiniothelia* species have neither covering clypeus nor star-like host remnants around the base as in *Astrosphaeriella*. The asci are obclavate with ellipsoid ascospores in *Kirschsteiniothelia*, while the asci are cylindrical to clavate with elongate fusiform ascospores in *Astrosphaeriella*. Two new species are described and illustrated in this study. Specimens examined are deposited at TNM (National Museum of Natural Science) and NCHUPP (National Chung Hsing University).

Taxonomy

Kirschsteiniothelia reticulata Chi Y. Chen, C.L. Wang & J.W. Huang, sp. nov.

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Fig. 1

Ascomata dispersa, primo immersa, demum per rimam laceratam protrusa, conica, 320–450 µm lata, 180–220 µm alta, ad apicem rotundata. Hyphae in matrice intercellulosae et intracellulosae, 3–5 µm latae, per cellulam parietem hospitii profunde constrictae. Paries ad later 20–40 µm crassus, ad basim lateralem ex cellulis parappellis constans, basi reducta. Asci obclavati, 90–110 × 23–27 µm, breviter pedicellati usque ad 15 µm longi. Pseudoparaphyses 1.5–2 µm crassae. Ascosporae ellipsoideae, 17–23 × 7–10 µm, atrobrunneae, unispatae, ornameto reticulato in facie, vaginis mucilaginosi obtectae.

Etymology: In reference to the reticulate ornamentation on ascospores

Holotype: TAIWAN. NANTOU HSIEN: Piluchi, on unknown twigs, Aug. 1999, C.L.Wang, TNM F19959.

Ascomata scattered, immersed at first, then erumpent through torn fissure of host, conical, 320–450 µm wide, 180–220 µm high, apex rounded; hyphae

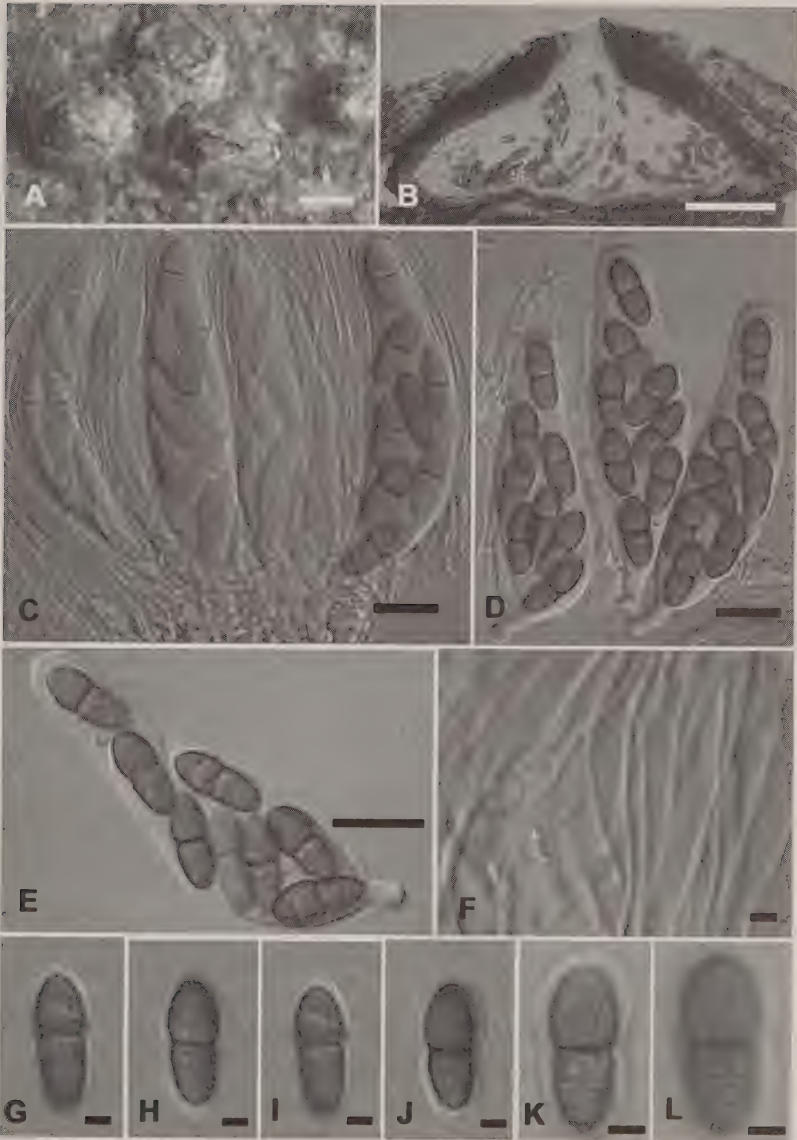


Figure 1. *Kirschsteiniothelia reticulata* (from holotype). A. Ascomata on host surface. B. Section of ascoma. C–E. Asci. F. Pseudoparaphyses. G–L. Ascospores.

Scale bars, A = 200 µm; B = 100 µm; C–E = 20 µm; F–L = 5 µm.

intercellular and intracellular in host, broad, 3–5 μm wide, deeply constricted where crossing host cell wall. Peridium 20–40 μm thick at sides, composed of cells forming a *textura angularis*, thickened around ostiolar canal and at lateral rim where cells usually arranged in palisade-like rows, at base reduced, usually merged with underlying host tissue. Asci obclavate, 90–110 $\times$ 23–27 μm , with a short stalk up to 15 μm long. Pseudoparaphyses frequently branched and anastomosing, 1.5–2 μm wide. Ascospores ellipsoid, 17–23 $\times$ 7–10 μm , dark brown, 1-septate, septum constricted, median or occasionally slightly deviating from middle, with reticulate ornamentation on surface, covered with mucilaginous sheath.

Notes: This species is characterized by ascospores ornamented with a reticulum of small ridges. It is an unique character previously not found in *Kirschsteiniothelia*. In *Kirschsteiniothelia*-related genera, this character only occurs in *Rousoella scabrispora* (Höhn.) Aptroot. However, judging from the illustration provided by Aptroot (1994), *R. scabrispora* is different in the shape of ascospores, which have no sheath and constriction.

Kirschsteiniothelia smilacis Chi Y. Chen, C.L. Wang & J.W. Huang, *sp. nov.*

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Fig. 2

Ascomata dispersa, similiter superficialia, extere e epidermide tenui obsita, conica, 450–600 μm lata, 200–300 μm alta, ad apicem rotundata. Hyphae in matrice intercellulosae, 2.5–4 μm latae, per cellulam parietem hospitis tenuiter filiformes. Paries 35–50 μm crassus, ex cellulis opacis, denigrates compositus, ad basem debiliter evolutus. Asci obclavati, 75–100 $\times$ 16–21 μm , breviter pedicellati usque ad 10 μm longi. Pseudoparaphyses 1–2 μm crassae. Ascosporae ellipsoideae, 20–24 $\times$ 6–8 μm , pallide brunneae, uniseptatae, ad septum leniter constrictae, inconspicue verrucosae, strato mucilagino indutae.

Etymology: From the host genus *Smilax* (*Smilacaceae*).

Holotype: TAIWAN. NANTOU HSIEN: Tsuifeng, on stem of *Smilax* sp., 15 Oct. 2002, C.Y. Chen, TNM F19960.

Ascomata scattered, superficial in appearance, externally covered with a thin layer of host epidermis, conical, 450–600 μm wide, 200–300 μm high, apex rounded; hyphae intracellular in host, broad, 2.5–4 μm wide, becoming thread-like crossing host cell wall. Peridium 35–50 μm thick, composed of opaque melanized cells, poorly developed at base where cells usually integrate with host tissue. Asci obclavate, 75–100 $\times$ 16–21 μm , short-stalked, stalk up to 10 μm long. Pseudoparaphyses 1–2 μm wide, frequently anastomosing and branched. Ascospores ellipsoid, 20–24 $\times$ 6–8 μm , pale brown, 1-septate, slightly constricted at septum, wall finely and inconspicuously verrucose, covered with mucilaginous sheath.

Other specimen examined: TAIWAN. NANTOU HSIEN: Meifeng, on stem of *Smilax* sp., 2 Nov. 2005, C.Y. Chen, NCHUPP c1105.

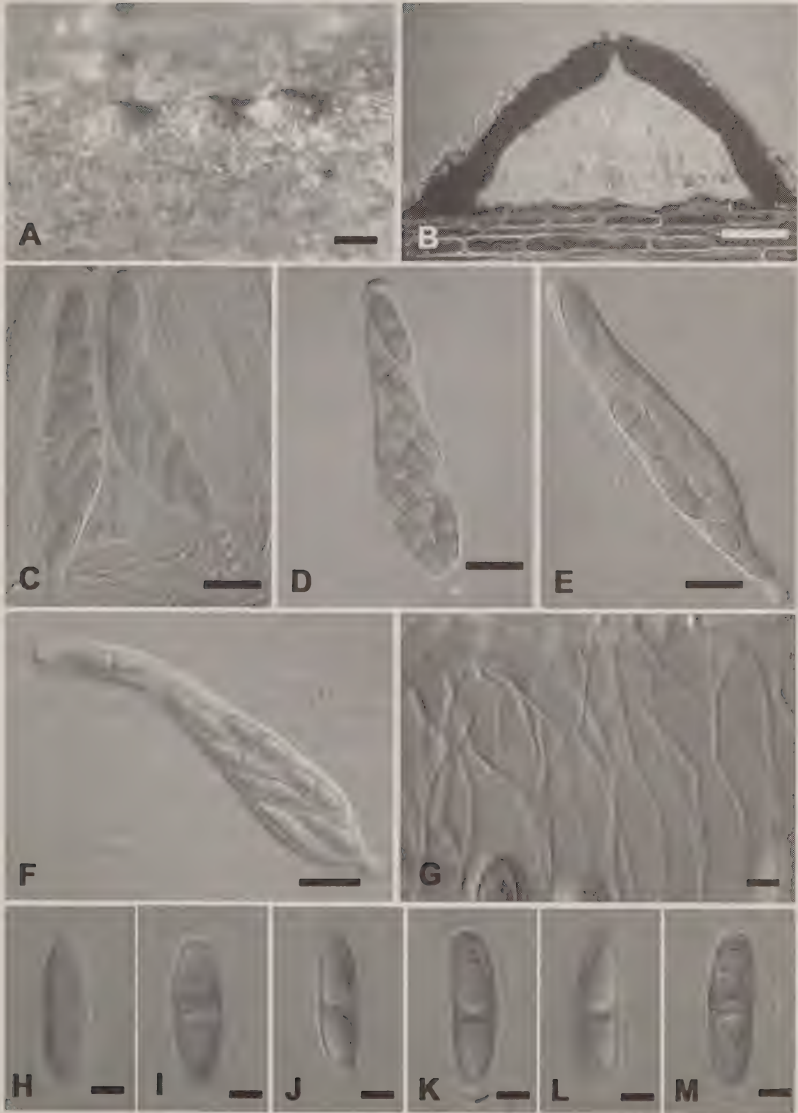


Figure 2. *Kirschsteiniothelia smilacis* (from holotype). A. Ascomata on host surface. B. Section of ascoma. C–F. Asci. G. Pseudoparaphyses. H–M. Ascospores.

Scale bars, A = 300 μ m; B = 100 μ m; C–F = 20 μ m; G–M = 5 μ m.

Notes: *Kirschsteiniothelia smilacis* occurs on the plant genus *Smilax*, not the bamboos or palms that are common hosts for *Astrosphaeriella* species (Chen & Hsieh 2004b Hyde & Fröhlich 1998).

Acknowledgements

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Aphyllphoraceous wood-inhabiting fungi on *Arbutus unedo* in Italy

SERGIO PÉREZ GORJÓN¹, ANNAROSA BERNICCHIA²
& TATIANA BAPTISTA GIBERTONI³

¹*spgorjon@usal.es* ²*aberniccc@agrsci.unibo.it* ³*tbgibertoni@hotmail.com*

¹*Departamento de Botánica & Centro Hispano-Luso de Investigaciones Agrarias
Universidad de Salamanca*

Ldo. Méndez Nieto s/n, 37007 Salamanca, Spain

²*Dipartimento di Scienze e Tecnologie Agroambientali,
Patologia Vegetale Università degli Studi di Bologna
Via Fanin 42, Bologna 40127 Italy*

³*Departamento de Micologia, Centro de Ciências Biológicas
Universidade Federal de Pernambuco
Av. Nelson Chaves s/n, 50670-420, Recife, Pernambuco, Brasil*

Abstract—Fifty-two species representing 32 aphyllphoraceous genera growing on *Arbutus unedo* in Italy are reported. *Phlebia longicystidiata* is reported as new from Italy while *Antrodia sandaliae* has previously been described as a new species associated with *A. unedo*. The complete checklist of fungi is available on <http://www.mycotaxon.com/resources/weblist.html>.

Key words—lignicolous fungi, diversity, Mediterranean, *Ericaceae*

Introduction

Italy, except for the north and mountainous areas, has a typically Mediterranean climate characterized by cold, rainy winters and dry summers that supports a particular vegetation type, called a sclerophyll forest, composed of trees and shrubs with hard leaves that are very resistant to changes in temperature and humidity. One of the most representative sclerophyllous plants is *Arbutus unedo* L. (*Ericaceae*), a 5–10 m tall evergreen shrub or tree with a variable trunk diameter that may be found growing on rocky slopes and (generally) acid soils. It often forms maquis, isolated or mixed with other plants, occasionally forming dense woods. *Arbutus unedo* is of great importance for the dynamics of vegetation because it grows rapidly after fires. The mild temperature and high environmental dampness are very important features that allow the development of large number of fungi. *Arbutus* woods, however, have not



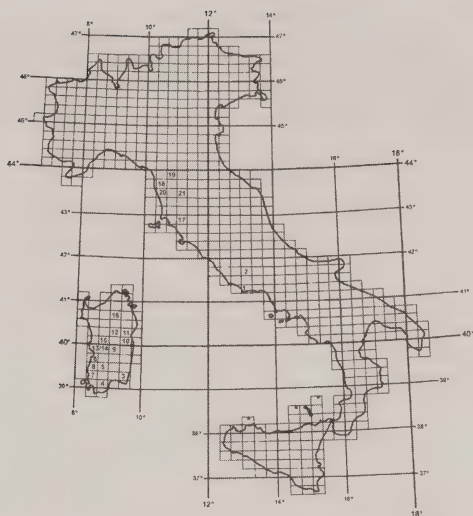
Map of approximate distribution of *Arbutus unedo* in the Mediterranean area

been well investigated from the mycological point of view and only scattered information can be found in literature. The distribution *Arbutus unedo* is limited to temperate zones, mainly in the Mediterranean region that includes Turkey and northern Africa (Figure 1). In Italy, *A. unedo* occurs naturally at the 500 m.a.s.l. elevation, although it may also be found until 1200 meters in some southern areas. The species is distributed throughout the islands and along the coastal zone, except for the North Adriatic area.

Materials and methods

During the last 25 years, fungi have been collected in the sites listed below. Samples were taken to the laboratory for microscopical examination and identifications followed Eriksson & Ryvarden (1973, 1975, 1976), Eriksson et al. (1978, 1981, 1984), Burdsall (1985), Hjortstam et al. (1988), Ryvarden & Gilbertson (1993, 1994), Bernicchia (2005), and Miettinen et al. (2006). All specimens are kept in Herbarium HUBO. The list is partially referred to Onofri (2005) and the nomenclature to Donk (1984), Parmasto (1997), Hjortstam (1998), Kirk et al. (2001), and CBS (2006).

Collection localities (see also Figure 2): Collections were taken from the following sites—(1) Lazio, Latina, National Park of Circeo; (2) Lazio, Roma, San Martino al Cimino; (3) Sardegna, Cagliari, Campu Omu; (4) Sardegna, Cagliari, Capoterra; (5) Sardegna, Cagliari, Collinas; (6) Sardegna, Cagliari, Gentilis; (7) Sardegna, Cagliari, Is Antiogus; (8) Sardegna, Cagliari, Sibiri; (9) Sardegna, Nuoro, Montarbu Forest; (10) Sardegna, Nuoro, Piana di Urzulei; (11) Sardegna, Nuoro, Pinery Arzana; (12) Sardegna, Nuoro, Supramonte di Orgosolo; (13) Sardegna, Oristano, Arci Mountain, (14) Sardegna, Oristano, Arci Mountain, Pau; (15) Sardegna, Oristano, Sossu Mountain; (16) Sardegna,



Map of Italy with the collecting sites. Scale 1:50000

Sassari, Badde Longa; (17) Toscana, Grosseto, Amiata Mountain; (18) Toscana, Livorno, Colognole; (19) Toscana, Livorno, Il Giardino Forest; (20) Toscana, Livorno, Bibbona Forest; (21) Toscana, Siena, Santa Agnese *Cupressus* Forest.

Results

In this survey, 52 species of aphylophoraceous wood-inhabiting fungi representing 32 different genera were identified as occurring on *Arbutus unedo*. Species are listed in alphabetic order; each site number (given in brackets) is followed by collection date, habitat, and herbarium number. Additional notes on distribution or abundance are given for some species. *Phlebia longicystidiata* is reported as a new record from Italy. Particularly rare or infrequent species are *Aleurodiscus cerussatus*, *Antrodia sandaliae*, *Intextomyces contiguus*, *Junghuhnia semisupiniformis*, *Mycoaciella bispora*, *Oligoporus simanii*, *Peniophora pilatiana*, *Phellinus rosmarini* and *Scytinostromella heterogenea*.

Conclusions

From an ecological point of view, the *Arbutus* maquis fulfil a series of suitable conditions for the development of lignicolous fungi and support high fungal diversity. Although many of the aphylophoraceous wood-inhabiting fungi listed above may also be found growing on conifers and other deciduous trees, at least one recently described species, *Antrodia sandaliae*, is expected to be found exclusively on *Arbutus unedo*, which makes this substrate worthwhile for mycological surveys.

Acknowledgements

We would like to thank Prof. Giuseppe Venturella and Dr. Ireneia Melo for critically reviewing the manuscript. The first author is supported by a research grant co-financed by the *European Social Fund* and the *Junta de Castilla y León* (Spain).

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Lysurus pakistanicus, a new species of *Phallales* from Pakistan

S. H. IQBAL¹, T. KASUYA², A. N. KHALID¹ & A. R. NIAZI¹

nasir@botany.pu.edu.pk

¹Department of Botany, University of the Punjab, Lahore 54590, Pakistan

s0310849@ipe.tsukuba.ac.jp

²Laboratory of Plant Parasitic Mycology, Institute of Agriculture and Forestry,
University of Tsukuba, Tsukuba, Ibaraki 305-8572, Japan

Abstract—A new species of a phalloid mushroom, *Lysurus pakistanicus*, is described from Lahore, Pakistan, based on its morphological characteristics.

Key words—gasteromycetes, lawn

Introduction

The phalloid genus, *Lysurus* Fr. is morphologically characterized by long-stipitate receptacles bearing vertical arms that may or may not be united transverse arms and with or without glebiferous processes emerging from the junctions (Dring 1980). This genus was monographed by Dring (1980) with only five species. Although *L. cruciatus* (Lepr. & Mont.) Henn. and *L. periphragmoides* (Klotzsch) Dring were hitherto recorded for Pakistan (Ahmad 1939, 1952; Ahmad et al. 1997), this genus has not yet been comprehensively studied. During the floristic investigations of macromycetes of Pakistan (Iqbal & Khalid 1996; Khalid & Iqbal 1995, 1996, 2004), an undescribed *Lysurus* was collected on lawn of the campus of University of the Punjab, Lahore. In this article, we describe this fungus as a new species based on results of morphological observations.

Materials and Methods

The material examined in this study is deposited in the Mycological Herbaria of the Department of Botany, University of the Punjab, Lahore, Pakistan (SHI) and the National Science Museum, Tokyo, Japan (TNS). Macroscopic characters were described by observations on fresh materials. For light microscopic observations, free-hand sections of gleba and peridium were

mounted in water and 1% (w/v) cotton-blue lactophenol on glass slides. Forty randomly selected basidiospores were measured under a light microscope at 1000x magnification.

Taxonomy

Lysurus pakistanicus S. H. Iqbal, Kasuya, Khalid & Niazi, *sp. nov.*

MYCOBANK MB 510257

Figs. 1-3

Ovo subgloboso vel ovoido, 18-25 x 20-30 mm diametro, epigaeo, albo vel cremeo-flavido. Gleba gelatinosa, obscura olivaceo-brunnea. Receptaculo formanti pseudostipite 50 mm alto, 15 mm lato in apice, 6 mm lato basi, cylindrico, infra angustato, pallido-flavo, flexo levilter, spongioso, fragili, cum reticulo clathrato globoso vel hemisphaerico 10-30 x 10-25 mm diametro, formanti brachia anastomosanti 6-10 ex loculo tubulato singulari, salmonio primum, aurantiaco-persicino in maturatione, denique expansis admodum. Basidiosporis ellipsoidis, 1.75-2.15 μ m x 3.85-5.25 μ m, paginis laevis, hyalinis. Odore foetida levilter.

Holotypus: Pakistan, Lahore, University of the Punjab, Quaid-e-Azam Campus, June 30, 2006, M. Rafi leg., Rafi #630 (SHI).

Etymology: The Latin *pakistanicus*, derived from Pakistan.

Basidioma solitary, fully expanded at maturity. **Egg** stage 18-25 x 20-30 mm in diameter subglobose to ovoid, epigeal, white to cream or yellowish, arising from a white mycelial strand that is 20 mm long, 2 mm thick. **Peridium** whitish, surface papery, inner fleshy, easily breakable, with hyaline, gelatinous endoperidium. **Gleba** gelatinous, dark olivaceous brown, at first fills the entire interior of the arms and extends outwards in the meshes. **Receptacle** a pseudostipe, 50 x 15 mm diam. near apex and 6 mm diam. near base, cylindrical, tapering below, pale yellow, slightly bending, spongy, hollow, covered with thin papery layer; wall of receptacle composed of up to 2-layered, numerous polygonal chambers. Apical receptacle as a irregular, globose to hemispherical, 10-30 x 10-25 mm in diameter clathrate network of anastomosing arms, with about 6-10, irregular to elongated meshes, salmon rosy at first, becoming orange pink at maturity. **Arms** triangular in section, each consisting of single, wide tube, transversely keeled outer and inner, fully opened at ultimate maturity. **Smell** weak, foetid.

Basidiospores 1.75–2.15 x 3.85-5.25 μ m, elliptical, smooth, thick-walled, hyaline. **Basidia** not observed.

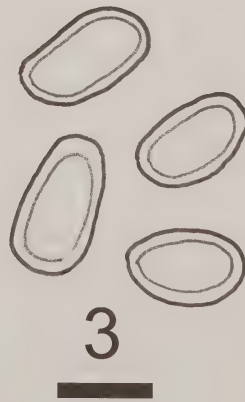
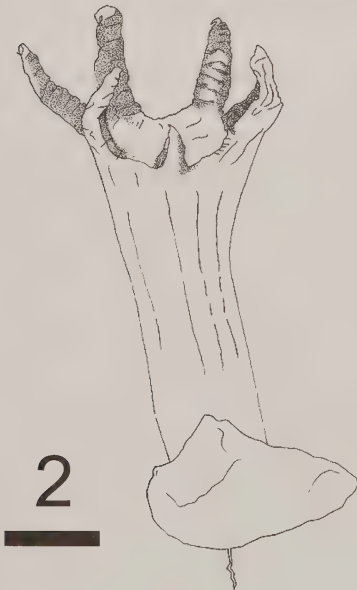
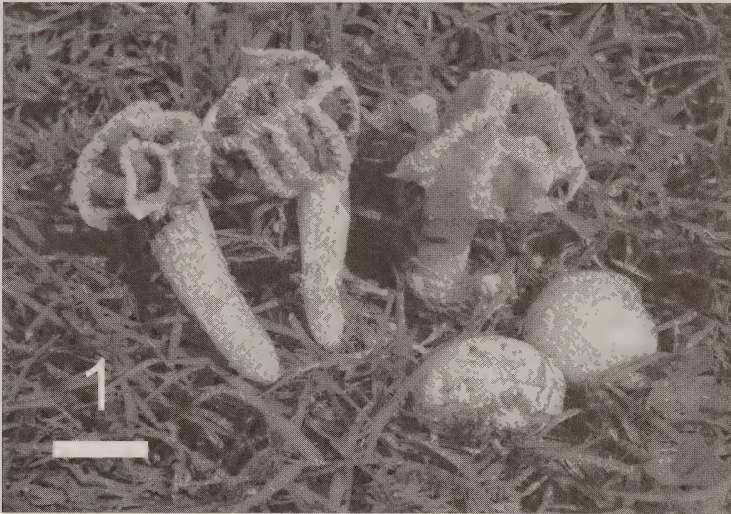
Habitat: Terrestrial in grass lawns.

Distribution: Known only from Pakistan (Lahore).

Materials examined: Pakistan, Lahore, University of the Punjab, Quaid-e-Azam Campus, June 30, 2006, M. Rafi, Rafi #630 (SHI, holotype), TNS-F-12540 (isotype); July 6, 2006, M. Rafi, Rafi #631 (SHI); August 2, 2006, M. Rafi, Rafi #632 (SHI).

Discussion

Two species of *Lysurus* have a receptacle that surmounts a clathrate network: *L. periphragmoides*, from pantropical to warm-temperate areas of the world



Figs. 1-3. *Lysurus pakistanicus*. 1: Immature (on the right) and young (on the left) basidiomata.

2: Mature basidioma. 3: Basidiospores.

Bars 1-2: 10 mm, 3: 3 μ m (from Rafi #630, SHI, holotypus).

(Conrad 1913, Long & Stouffer 1948, Dring 1980, Dominguez de Toledo 1995), and *L. corallocephalus* Welw. & Curr., known only from tropical Africa (Dring 1964, 1980). While the receptacle of *L. pakistanicus* is morphologically very similar to *L. periphragmoides*, both can easily be separated based on clathrate head, shape and size of the pseudostipe, and basidiospore length. In the former, the hollow, narrowly obconical pseudostipe bears an irregularly oblong to hemispherical clathrate network of mesh, while in the latter the head of the receptacle is subglobose or ovoid. The meshes formed by the anastomosis of the arms are irregular to cylindrical, up to 10 in number in *L. pakistanicus* but reaching 100 in *L. periphragmoides*. The meshes in *L. periphragmoides* are isodiametric and pentagonal to hexagonal. The size of the netted clathrate head is 10 mm longer in *L. periphragmoides*. *L. periphragmoides* is further distinguished by having a geranium pink pseudostipe that is twice as long as that possessed by *L. pakistanicus*. Basidiospores of *L. periphragmoides* are similar, $1.5\text{--}2 \times 4\text{--}4.5 \mu\text{m}$ (Dring 1980).

Lysurus corallocephalus, with its white to yellowish receptacle surmounting a clathrate network, also morphologically resembles *L. pakistanicus*. However, *L. corallocephalus* is well distinguishable in possessing a network bearing erect, simple or branched, coralloid appendages at intersection of arms, and gleba located on the outer arm surfaces.

Lysurus cruciatus, with a worldwide distribution (Bottomley 1948, Dring 1980), can also be considered close to *L. pakistanicus* for their pseudostipe. Both species produce a narrowly obconical pseudostipe, but that of *L. cruciatus* is 2 times longer than *L. pakistanicus*. Both can also be separated on the basis of the mature receptacle. In *L. cruciatus* the pseudostipe is surmounted by 4–7 vertical columns that are usually free at their tips and tending to curve away from the axis (Dring 1980). In case of *L. pakistanicus*, clathrate netted head is composed of meshes that have been formed by the anastomosis of arms. The arms of *L. cruciatus* are smooth on the adaxial surface but strongly grooved down the entire adaxial surface (Dring 1980). Basidiospores in *L. cruciatus* are elliptical to cylindrical, $1.5\text{--}2 \times 4\text{--}4.5 \mu\text{m}$ long (Dring 1980).

The present fungus is characterized by basidiomata that are 68–75 mm tall with pale yellow, narrowly obconical pseudostipes that are surmounted by irregularly globose to hemispherical clathrate networks of anastomosing arms. The meshes formed by the arms are irregular to oblong, cylindrical, up to 10 in number, and salmon rosy to orange pink. Also diagnostic are the open arms at ultimate maturity. Finally, after complete morphological observations of Pakistani specimens and literature review of *Lysurus*, we concluded that the above characteristics justify the introduction of a new species, *L. pakistanicus*.

Key to the species of *Lysurus*

1. Receptacle surmounts a clathrate network 2
- 1'. Receptacle surmounts simple erect arms 4
2. Network devoid of coralloid appendages. Gleba located on inner surface and side of the arms 3
- 2'. Network bearing erect simple or branched, coralloid appendages at intersection of arms. Gleba located on outer surface of the arms *L. corallocephalus*
3. Network irregularly oblong to hemispherical, consists of up to 10 meshes. A pseudostipe of receptacle is pale yellow. Basidiospores $1.75-2.15 \times 3.85-5.25 \mu\text{m}$ *L. pakistanicus*
- 3'. Network subglobose to ovoid, consists of up to 100 meshes. Pseudostipe is geranium pink. Basidiospores $1.5-2 \times 4-4.5 \mu\text{m}$ *L. periphragmoides*
4. Pseudostipe 4-6-angled, arms often attached a sterile pointed apex *L. mokusin*
- 4'. Pseudostipe cylindrical to obconical, arms often becoming free at the apex 5
5. Arms with a well marked, narrow, sterile base. Basidiospores elliptical, $1.5 \times 4-5 \mu\text{m}$ *L. gardneri*
- 5'. Arms without sterile base. Basidiospores elliptical to cylindrical, $1.5-2 \times 4-4.5 \mu\text{m}$ *L. cruciatus*

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Two new species of *Mycosphaerella* on milk tree, *Sapium glandulosum*, from Brazil

DARTANHA J. SOARES, DOUGLAS F. PARREIRA & ROBERT W. BARRETO

dartjs@yahoo.com.br

Departamento de Fitopatologia, Universidade Federal de Viçosa
Viçosa, Minas Gerais, 36570-00, Brazil

Abstract—Two new species of *Mycosphaerella* (Ascomycota, *Mycosphaerellaceae*) are described on *Sapium glandulosum* from Brazil. Both *Mycosphaerella sapiicola* and *M. sapii* differ in ascospore shape and size from the other species of *Mycosphaerella* described on *Sapium* (*M. sodiroana*). An anamorph belonging to *Septoria* was also found associated with *M. sapii*. The type of *M. sodiroana* was reexamined and is illustrated here for the first time.

Key words—*Alchornea sodiroi*, fungal diversity, mycobiota, *Sapium aucuparium*, tropical fungi

Introduction

Sapium glandulosum (L.) Morong (milk tree) belongs to the *Euphorbiaceae* and is native to and widespread in Central and South America (Kruijt 1996). It has potential as an ornamental tree (Lorenzi 2002) but it is best known for being poisonous to mammals (Lampe & McCann 1985). Although widely distributed, little is known about its mycobiota. A literature survey yielded eight fungal records on this host and its synonyms: *Cercospora sapiicola* Speg., *Cytosporina sapii* Speg., *Uromyces cisnerioanus* Speg., *Uromyces globosus* Dietel & Holw., *Zygosporium* sp. (Farr et al. 2006), and *Helminthosporium guaraniticum* Speg., *Microthyriella rimulosa* (Speg.) Theiss., *Sphaeropsis sapii* (Speg.) Sacc. (Viégas 1961). None of these records were from Brazil (Mendes et al. 1998, Silva & Minter 1995) except for *U. cisnerioanus* which was recorded on *Sapium* sp. (cf. *aucuparium*) in the states of São Paulo and Rio de Janeiro (Lindquist 1982, Hennen et al. 2005).

Knowledge of the Brazilian mycodiversity in general, and particularly of the state of Minas Gerais (MG), is still scarce. Surveys of fungi associated with native plants, with particular reference to Viçosa-MG and neighboring areas have been on-going since 2003, resulting in some newly-discovered fungal taxa and fungus-host associations (Pereira & Barreto 2006, Pereira et al. 2006, Soares et al. 2006a, Soares et al. 2006b, Soares & Barreto 2005, Vieira et al. 2005).

In July 2004, during a survey in the natural reserve 'Parque Estadual da Serra do Brigadeiro' in the state of Minas Gerais (Brazil), plants identified as *S. glandulosum* were found showing two distinct types of foliar spots. In a preliminary examination, both spots had fruit bodies of *Mycosphaerella* (Ascomycota, *Mycosphaerellaceae*) consistently associated with them. After a more detailed examination, it was found that distinct species were associated with each kind of leaf spot, one of which was also producing a *Septoria* anamorph.

Although about twenty-eight species and one variety of *Mycosphaerella* have been recorded in the family *Euphorbiaceae* (Sivanesan & Shivas 2002, Farr et al. 2006), only one species has been described previously on '*Sapium*', viz. *Mycosphaerella sodiroana* Petr., on '*Sapium sodiroi*' from Ecuador (Petrak 1950). However, as the epithet '*sodiroi*' is not listed under the genus *Sapium* in either the Missouri Botanical Garden (W3Tropicos 2006) or in the International Plant Names Index (IPNI 2006), it is probable that the plant Petrak designated as '*S. sodiroi*' was *Alchornea sodiroi* Pax & K. Hoffm. (*Euphorbiaceae*), an Ecuadorian endemic (S. Pennycook pers. comm. 2006). However the status of '*Sapium sodiroi*', cannot be resolved here, and this would require a molecular study since only leaves are present in Petrak's type. Therefore, until future evidence is forthcoming we must accept that *M. sodiroana* is on a *Sapium* host and that this is still the only recognized *Mycosphaerella* species on that host genus. The fungi from the Serra do Brigadeiro were found to be distinct from *M. sodiroana* and are described below.

Material and methods

Infected leaves of *Sapium glandulosum* were collected from this tree host in a stretch of Atlantic rainforest in the Serra do Brigadeiro. The samples were dried in a plant press and later examined under a dissecting microscope. Semi-permanent slides containing hand-free or cryomicrotome sections of the fungal structures were mounted using lactophenol or lacto-fuchsin and sealed with nail varnish. Observations, measurements and line drawings were prepared with an Olympus BX 50 light microscope fitted with a drawing tube. Representative specimens of the fungi were deposited in the herbarium at the Universidade Federal de Viçosa (Herbarium VIC).

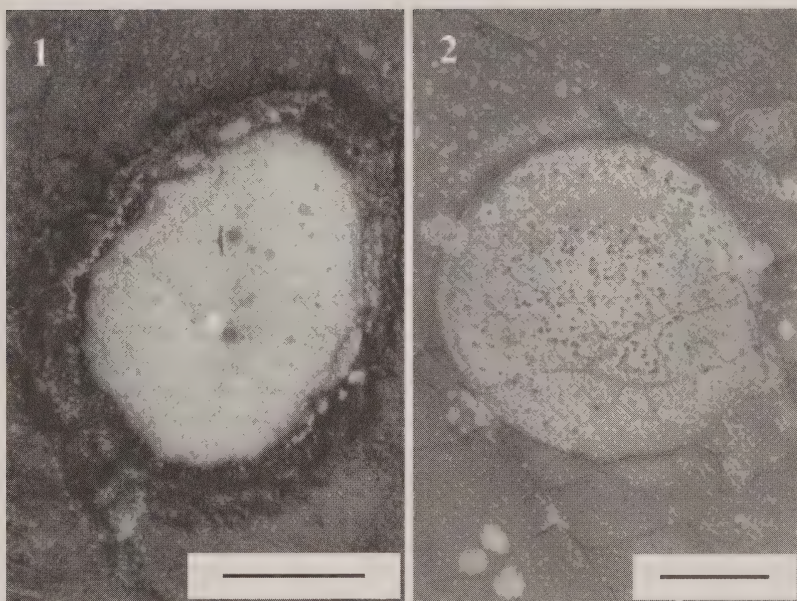
Taxonomic description

Mycosphaerella sapii D.J. Soares, Parreira & R.W. Barreto, sp. nov.

MYCOBANK MB510072

(FIGS 1, 5 and 6)

Differt a *M. sodiroana* maculae amphigenae, albidae, cum margine nigrae incrassatae elevatae. Ascomata singularia, 70–250 μm diam., asci 56–74 $\times$ 10–13.5 μm . Ascosporae 14–19 $\times$ 3–4 μm . Conidiomata pycnidial, 60–150 μm diam. Cellulae conidiogenae,



Figs. 1-2. Symptoms of *Mycosphaerella sapii* (1) and *Mycosphaerella sapiicola* (2) ex type. For details see text. Scale bars = 5 mm.

phialidicae, *ampulliformis* vel *subcylindrica*, *hyalinae*, $6.5\text{--}13.5 \times 1.5\text{--}3.5 \mu\text{m}$. *Conidia cylindrica*, *hyalinae*, *pluriseptata*, $34\text{--}65 \times 1.5\text{--}2 \mu\text{m}$.

Anamorph: *Septoria* sp.

Etymology: named in reference to host genus.

Holotype: Brazil, state of Minas Gerais, Araponga, Serra do Brigadeiro, $20^{\circ}35'26''$ S $42^{\circ}24'07''$ W, on *Sapium glandulosum*, July 2004, D.J. Soares (VIC-29380).

Leaf spots amphigenous, circular to subcircular or elliptic, 2.5–8 mm wide, separate, whitish, surrounded by a thick and raised black border. *Pseudothecia* epigenous, single, scattered, globose to subglobose, 70–250 μm diam., brown, subepidermal becoming erumpent, walls of 3–5 layers of brown *textura angularis* cells. *Asci* fasciculate, bitunicate, apophysate, eight-spored, obclavate to cylindrical, widest above the middle, sessile to short pedicellate, straight to slightly curved, $56\text{--}74 \times 10\text{--}13.5 \mu\text{m}$. *Ascospores* biserial to inordinate, overlapping, fusiform, with subacute ends, $14\text{--}19 \times 3\text{--}4 \mu\text{m}$, thick-walled, hyaline, 1-septate, guttulate. *Conidiomata* pycnidial, globose, subepidermal, becoming erumpent, 60–150 μm diam., apical ostiole 5–7 μm diam., thin-walled, 3–3.5 μm , with light brown *textura angularis* cells. *Conidiophores* reduced to *conidiogenous cells*, phialidic, ampulliform to subcylindrical, 6.5–

13.5 × 1.5–3.5 µm, hyaline. *Conidia* cylindrical, straight to sinuous, 34–65 × 1.5–2 µm, multiseptate, mostly 4–7 septate, hyaline.

Comments — This species is easily distinguished from *M. sodiroana* by ascospore size (Table 1). Only few foliar lesions containing material belonging to this taxon were found, and under the dissecting microscope it was impossible to distinguish pseudothecia from pycnidia, but it was observed that pseudothecia were more commonly found in the center of the lesions whereas the pycnidia were more abundant near the edges. According to Sutton (1980), the type species of *Septoria* (*S. cytisi* Desm.) has holoblastic sympodial conidiogenesis, but holoblastic development and no sign of sympodial or percurrent proliferation, as well as phialides were also recorded. Therefore, Sutton considered *Septoria* as heterogeneous.

Recent molecular studies demonstrate that roughly at least three lineages are present in the genus *Septoria* and that it is not monophyletic within *Mycosphaerella* (Verkley et al. 2004). Distinct conidiogenesis, percurrent and sympodial proliferation, even in a single conidiogenous cell, can occur; although the conidiogenous cells of the anamorph of *M. sapii* are described as phialidic, it is possible that we are misinterpreting “cryptically proliferating cells, which under the light microscope easily can be mistaken for phialides” as reported for *S. chrysanthemella* (Verkley 1998). Moreover a recent study (Priest 2006) accepted four distinct conidiogenous cell events for the genus *Septoria*: holoblastic simple, holoblastic sympodial, enteroblastic non-progressive and enteroblastic percurrent. At the present no new arrangement, for *Septoria* species with conidiogenesis cells distinct from that of *Septoria cytisi*, has been proposed, so the placement of the anamorph of *M. sapii* in the genus *Septoria* was based on *Septoria* sensu Sutton (1980) that also includes taxa with apparently non-proliferating, phialidic conidiogenous cells.

Mycosphaerella sapiicola D.J. Soares, Parreira & R.W. Barreto, *sp. nov.*

MYCOBANK MB510073

(FIGS 2-3)

Differt a M. sodiroana macullae amphigenae, brunneae. Ascumata singularia, 65–110 µm diam. Asci 28–30.5 × 6.5–7.5 µm. Ascosporae, non constrictae, latissime at septum, 10–15.5 × 2–2.5 µm, biseriatae vel inordinate.

Etymology: named in reference to host genus.

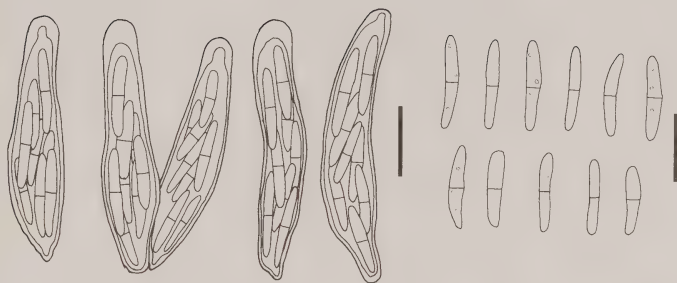
Holotype: Brazil, state of Minas Gerais, Araponga, Serra do Brigadeiro, 20°35'26" S 42°24'07" W, on *Sapium glandulosum*, July 2004, D.J. Soares (VIC-29380).

Leaf spots amphigenous, circular to subcircular, 3.5–19 mm wide, separate, grey to pale brown with a thin, dark brown border. *Pseudothecia* epigenous,

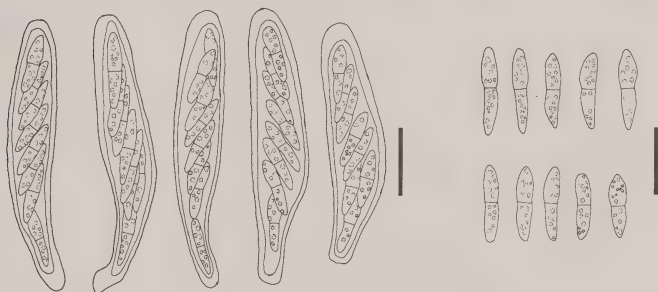
Figs. 3-5. Line drawing of *Mycosphaerella* spp. on *Sapium* spp. ex type. 3- Asci and ascospores of *Mycosphaerella sapiicola*; 4- Asci and ascospores of *Mycosphaerella sodiroana*; 5- Asci and ascospores of *Mycosphaerella sapii*.

Scale bars = 10 µm.

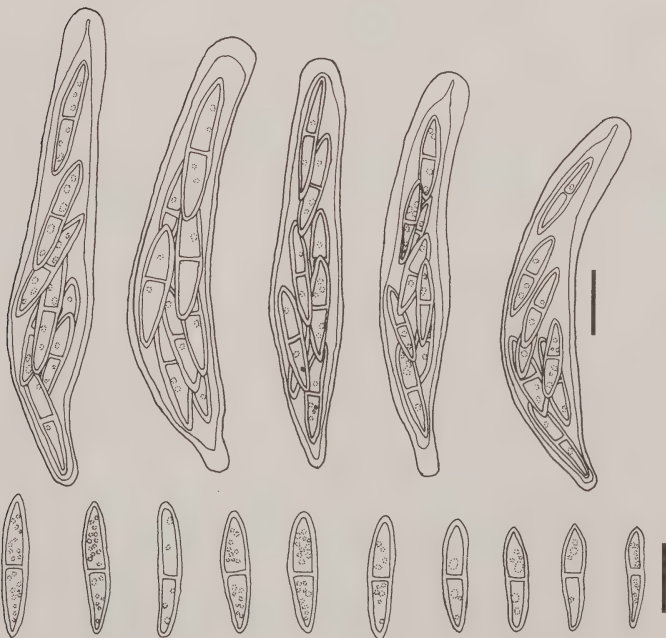
3



4



5



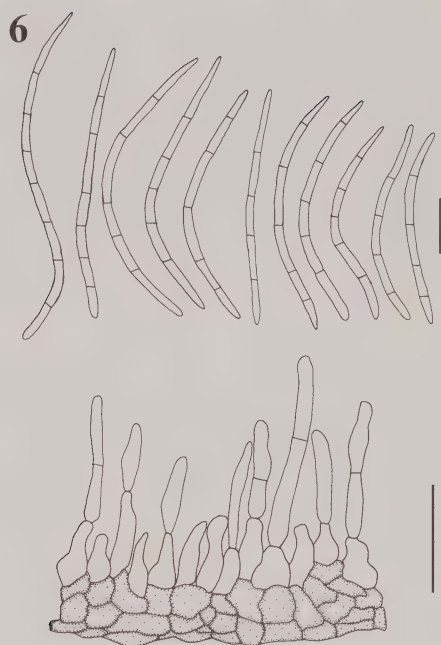


Fig. 6. Line drawing of the anamorph of *Mycosphaerella sapii* on *Sapium glandulosum*.
Scale bars = 10 µm.

single, scattered at the periphery of lesions, aggregated in the center, globose to subglobose, 65–110 µm diam. dark brown, subepidermal becoming erumpent, walls of *textura angularis* 6–9.5 µm thick. *Asci* fasciculate, bitunicate, aparaphysate, eight-spored, obclavate to cylindrical, sessile to short pedicellate, straight to slightly curved, 28–30.5 × 6.5–7.5 µm. *Ascospores* biserial to inordinate and overlapping, cylindrical to fusiform, with rounded ends, 10–15.5 × 2–2.5 µm, 1-septate, thin-walled, smooth, hyaline, with or without guttules.

Comments — We have examined Petrak's type of *M. sodiroana* (Herbarium S, Reliquiae Petrakianae 659, on '*Sapium sodiroi*', Ekuador: Prov. Tungurahua, Hacienda San Antonio bei Baños, 20.12.1937) and concluded that the specimen from *S. glandulosum*, although biometrically similar (Table 1), is a distinct taxon. On Petrak's description an excellent account of the fungus is given but no illustration was provided by the author. While *M. sodiroana* does not develop clear lesions and has ascospores that are densely and minutely guttulate, slightly constricted at the septum, widest in the upper cell, mainly clavate to fusiform which are uniserially arranged (Fig. 4), *M. sapicola* is associated with circular lesions, has ascospores with or without guttules, that are not constricted

Table 1. Morphological characters of *Mycosphaerella* spp. on *Sapium* spp.

Features		<i>M. sodiroana</i>	<i>M. sapii</i>	<i>M. sapiicola</i>
Ascoma		60–100 µm diam	70–250 µm diam	65–110 µm diam
Asci	shape	clavate to cylindrical-clavate	obclavate to cylindrical	obclavate to cylindrical
	size	30–40 × 5–7 µm	56–74 × 10–13.5 µm	28–30.5 × 6.5–7.5 µm
Ascospores	shape	clavate to fusiform	fusiform	cylindrical to fusiform
	size	8–12 × 2–3.5 µm	14–19 × 3–4 µm	10–15.5 × 2–2.5 µm
	guttules	guttulate	guttulate	guttulate / eguttulate
	arrangement	uniseriate	biseriate to inordinate	biseriate to inordinate
Anamorph		unknown	<i>Septoria</i> sp.	unknown
Habit		on fallen leaves of ' <i>S. sodiroi</i> '	on living leaves of <i>S. glandulosum</i>	on living leaves of <i>S. glandulosum</i>

at the septum, widest in the middle, cylindrical to fusiform and biseriate to inordinately arranged within the asci. *M. sapiicola* is easily distinguished from *M. sapii* by the size of asci and ascospores (Table 1). In addition, *M. sapiicola* has thin-walled ascospores, with rounded ends and with or without guttules, *M. sapii* has thick-walled ascospores, with subacute ends and is minutely and densely guttulate, similar to *M. sodiroana*.

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Contributions to the macrofungi of Kastamonu province, Turkey

DURSUN YAĞIZ¹, AHMET AFYON¹,
MUHSIN KONUK², & STEPHAN HELFER³

dyagiz@selcuk.edu.tr aafyon@selcuk.edu.tr
mkonuk@aku.edu.tr s.helfer@rbge.org.uk

¹Selcuk University, Education Faculty, 42099, Meram, Konya-TURKEY

²Afyon Kocatepe University, Faculty of Art and Science, Afyonkarahisar-TURKEY

³Royal Botanic Garden Edinburgh, 20A Inverleith Row, Edinburgh EH3 5LR, U.K.

Abstract—This study was based on specimens of macrofungi collected from Kastamonu province between 1998 and 2000. Field and laboratory identification revealed 197 taxa belonging to 34 families (4 families of *Ascomycotina* and 30 families of *Basidiomycotina*). 13 new taxa were added to the Turkish mycota as new records. The full checklist is available at <http://rbg-web2.rbge.org.uk/mycotaxon/140.pdf>

Key words—macromycota, flora, A4–A5 floristic squares, fungi

Introduction

This research was carried out in Kastamonu province (Figure 1), which is situated in the western Black Sea Region of Turkey. The western Black Sea Region is situated from west of Kızılırmak river delta to the east of Adapazarı and Bilecik provinces. Kastamonu is placed in squares A4–A5 according to the floristic system of Davis (1965–1985). Three rainfall regimes (Akman 1990) are prevalent in the study area: A) near the Black Sea coast the second type of oceanic rain fall regime, B) around Kastamonu central-Taşköprü the semi continental rain fall regime, and C) in Daday-Araç-Ilgaz a transition rain fall regime.

The canopy vegetation of the study area is composed mainly of conifers (*Pinus nigra*, *P. sylvestris*, *Abies nordmanniana*) and broadleaved trees (*Populus alba*, *Salix alba*, *Quercus pubescens*, *Q. petraea*, *Q. macranthera*, *Q. hartwissiana*, *Fagus orientalis*). Previous mycological investigations were carried out by Öder (1982), Afyon (2001 a, b), and Afyon & Konuk (2001a, b). No further studies are known from the area but Afyon et al. (2004, 2005), Yağız et al. (2005) and

Sesli & Denchev (2005) produced checklists of adjacent regions.

Although parts of the area have been intensively managed for timber production, forest cover is almost intact (WWF 2006) and a small part of Ilgazdağı Mountain National Park is situated within the research area. Many of its habitats are ideal for mycological studies. The work presented here is the most up-to-date and extensive list of macrofungi of Kastamonu province. Ilgazdağı mountain is mainly situated in Çankırı province. Some foot hills extend into to Kastamonu. Since it is a huge mountain a separate study should be planned for it in its entire area. According to the report of the Kastamonu local environmental and Forestry authority, it has various types of topography, climate and soil (Kastamonu 2004). The members of the *Russulaceae* growing under oak, pine, and beech trees form ectomycorrhizae with them according to Öder (1988). The members of *Boletaceae* under pine and beech trees form ectotroph mycorrhizae with their roots.

Materials and methods

Specimens were collected from the research area during field trips between 1998 and 2000. The macroscopic and ecological characters of the specimens were recorded in situ and their microscopic features determined in the laboratory. The diagnoses of the taxa were carried out as described in previous studies (Afyon et al. 2005; Yağız et al. 2006). Taxa and their authors are given according to an amended list of authors of fungus names CABI Bioscience electronic

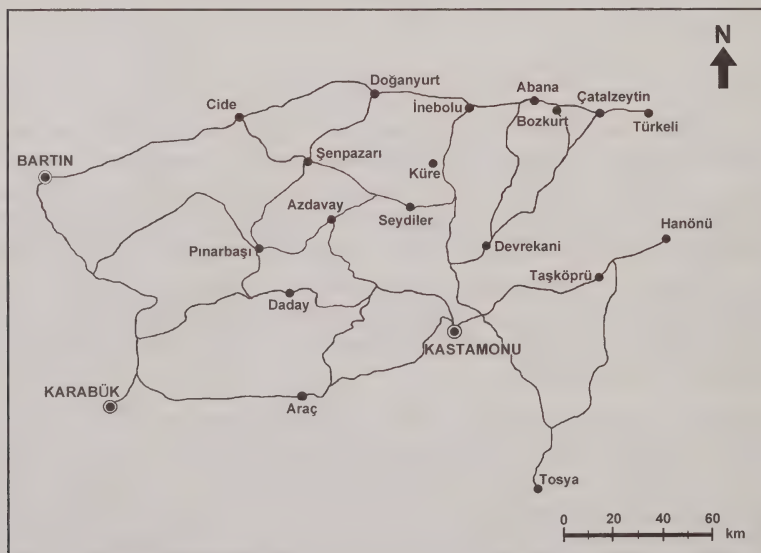


Figure 1: Map of the study area.

version (<http://www.indexfungorum.org/Names/Names.asp>). The specimens are kept at Selcuk University, Education Faculty Herbarium (KNYA).

Results

In our study, 197 species were recovered belonging to 34 families. The distribution of the species and their families are: *Discinaceae* 1, *Helvellaceae* 3, *Morchellaceae* 3, *Pezizaceae* 1, *Agaricaceae* 12, *Bankeraceae* 3, *Bolbitiaceae* 13, *Boletaceae* 10, *Cantharellaceae* 1, *Clavariaceae* 1, *Clavulinaceae* 1, *Cortinariaceae* 20, *Dacrymycetaceae* 1, *Entolomataceae* 1, *Ganodermataceae* 2, *Gastraceae* 2, *Gomphaceae* 1, *Gomphidiaceae* 3, *Hydnangiaceae* 2, *Hygrophoropsidaceae* 1, *Hymenochaetaceae* 1, *Lycoperdaceae* 9, *Marasmiaceae* 7, *Nidulariaceae* 1, *Phallaceae* 1, *Plutaceae* 10, *Polyporaceae* 5, *Psathyrellaceae* 3, *Rhizopogonaceae* 2, *Russulaceae* 26, *Sclerodermataceae* 1, *Strophariaceae* 3, *Suillaceae* 4, *Tricholomataceae* 41, and *Tulostomataceae* 1. Their collection dates, localities, habitats, collector's names and herbarium numbers are given in the list published on the internet at <http://rbg-web2.rbge.org.uk/mycotaxon/140.pdf>.

Discussion

197 species of macrofungi were collected from Kastamonu province, Turkey. Eight of them belonged to *Ascomycotina* and 189 to *Basidiomycotina*. Öder (1982) reported 15 macromycota from the study area. Afyon & Konuk (2001 a) reported 26 species of edible macrofungi known by local people from the entire western Black Sea Region of Turkey. 20 of these grow in Kastamonu. An additional 36 species of poisonous macrofungi were reported by Afyon & Konuk (2001 b) for the entire western Black Sea Region and 18 of them occurred in Kastamonu province. Moreover, Afyon (2001 a) reported four new Turkish records belonging to *Entolomataceae* two of which had been recorded from Kastamonu province. A further two species of *Hygrophoraceae* were reported by Afyon (2001 b) as part of five new records from the western Black Sea Region. The present report vastly increases and complements the results from these studies. Reports from neighbouring regions of the study area were: Afyon et al. (2000) 62 taxa from Bartın; Afyon & Konuk (2002) 77 taxa from Zonguldak; Afyon et al. (2004) 170 taxa from Sinop; Yağız et al. (2005) 121 taxa from Karabük; Afyon et al. (2005) 80 wood-decaying taxa from the western Black Sea Region; Yağız et al. (2006) 277 taxa from Bolu and Düzce provinces. When comparing taxa given from neighbouring areas, the present study gives a very high number of recorded data. Furthermore, Kastamonu province seems to be the richest area for its macrofungi diversity. This could be because of its climatic diversity and vegetation types in its different parts as described above.

13 taxa were added to the Turkish mycoflora as new records from the study area. These are: *Cystolepiota adulterina*, *Hebeloma pusillum*, *Boletus*

subappendiculatus, *Cortinarius isabellinus*, *C. renidentoides*, *C. spilomeus*, *C. talus*, *Inocybe mixtilis*, *I. petiginosa*, *Armillaria borealis*, *Tricholoma arvernense*, *T. basirubens*, and *T. cingulatum*.

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Notes on some Japanese smut fungi. III.

Ustilago moehringiae

CVETOMIR M. DENCHEV^{1*}, MAKOTO KAKISHIMA²,

HYEON-DONG SHIN³ & SEUNG-KYU LEE⁴

cmdenchev@yahoo.co.uk

¹*Institute of Life Science and Natural Resources*

Korea University, Seoul 136-701, Korea

kaki@sakura.cc.tsukuba.ac.jp

²*Graduate School of Life and Environmental Sciences*

University of Tsukuba, Tsukuba, Ibaraki 305-8572, Japan

hdshin@korea.ac.kr

³*Division of Environmental Science and Ecological Engineering*

Korea University, Seoul 136-701, Korea

leesk77@foa.go.kr

⁴*Laboratory of Forest and Shade Tree Pathology*

Korea Forest Research Institute, Seoul 130-712, Korea

Abstract—A new combination in *Haradaea* is proposed for *Ustilago moehringiae* on *Moehringia trinervia* var. *platysperma*. The fungus is described and illustrated based on revision of the authentic specimens.

Key words—*Caryophyllaceae*, Japan, *Microbotryum*, taxonomy

Introduction

Recently, it has been demonstrated that the genus *Microbotryum* should be reduced only to the group of the anthericolous species (incl. *M. majus*) on *Caryophyllaceae* (Almaraz et al. 2002, Denchev et al. 2006, Kemler et al. 2006). For accommodation of the seed-destroying species of *Ustilago* on *Caryophyllaceae*, a new genus, *Haradaea*, was described (Denchev et al. 2006) uniting seven species: *H. alsineae* (G.P. Clinton & Zundel) Denchev & H.D. Shin, *H. arenariae-bryophyllae* (Vánky) Denchev & H.D. Shin, *H. duriaeana* (Tul. & C. Tul.) Denchev & H.D. Shin, *H. holostei* (de Bary) Denchev & H.D. Shin, *H. jehudana* (Zundel emend. Denchev) Denchev & H.D. Shin, *H. moenchiae-manticae* (Lindtner) Denchev & H.D. Shin, and *H. nivalis* (Liro)

*Author for correspondence

Denchev & H.D. Shin. In the article establishing *Haradaea* (Denchev et al. 2006), the results of Amaraz et al. (2006), based on ITS rDNA, were taken into consideration and cited. After the publication of *Haradaea*, however, it was learned that the sequences that they reported as being from *Ustilago duriaeana* were, in fact, those of *Cryptococcus* spp. due to contamination (Ch. Roux, pers. comm.). Nevertheless, the results from the investigated sequences of the other specimens in this article, as well as those in Kemler et al. (2006), confirm the proposal that *Microbotryum* should be restricted to the group of anthericolous species on *Caryophyllaceae*. On the basis of our current knowledge the seed-destroying species on *Caryophyllaceae* should not be treated as species of either *Ustilago* or *Microbotryum*, as they have been traditionally and in many recent literature sources (cfr Vanky 1994, 1998), but as members of either *Haradaea* or *Bauhinus*. Definitive assignments, though, must await further molecular and/or ultrastructural investigations.

In connection with the revision of Japanese smut fungi, we studied the type of *Ustilago moehringiae*, a seed-destroying species on *Moehringia trinervia* var. *platysperma* (*Caryophyllaceae*). Because the correct place of this smut fungus is neither in *Ustilago* nor in *Microbotryum*, a new combination in *Haradaea* is proposed herein.

Materials and methods

Herbarium material from the collections of Hokkaido University, Sapporo (SAPA) and the Department of Botany, National Science Museum, Tsukuba (TNS) was examined under light (LM) and scanning electron (SEM) microscopy. For LM observations, the spores were mounted in lactophenol solution on glass slides by gently heating to the boiling point and then cooling. The measurements of spores are given in the form: min-max (mean $\pm$ 1 standard deviation). In the description, a symbol 'n/x=' is used to indicate the total numbers of measured collections and spores, respectively. For SEM, the spores were attached to specimen holders by double-sided adhesive tape and coated with platinum with a Hitachi E-1010 Ion Sputter. The surface structure of spores was observed and photographed with a Hitachi S-3500N Scanning Electron Microscope.

New combination proposed

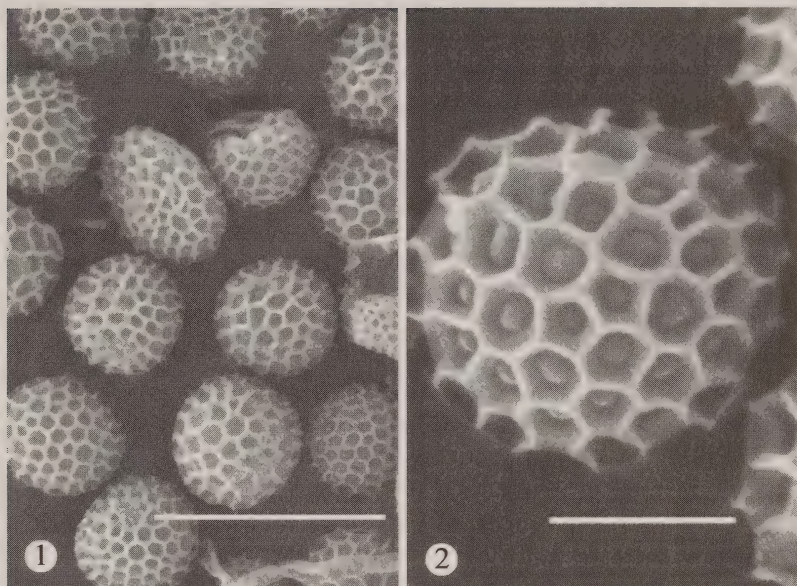
Haradaea moehringiae (Togashi & Y. Maki) Denchev, comb. nov.

MYCOBANK # MB510498

Figs. 1-2

Basionym: *Ustilago moehringiae* Togashi & Y. Maki, Ann. Phytopathol. Soc. Japan 10: 139, 1940.

= *Microbotryum moehringiae* (Togashi & Y. Maki) Vanky, Mycotaxon, 67: 46, 1998.



Figs. 1-2. *Haradaea moehringiae* on *Moehringia trinervia* var. *platysperma* (SAPA) – spores in SEM.
Scale bars: 1 = 20 µm, 2 = 5 µm.

Sori in the ovaries, destroying the seeds and filling the capsules with a spore mass. **Spore mass** powdery, purplish brown. **Spores** mainly globose or subglobose, rarely broadly ellipsoidal or ovoid, $11.5\text{--}15 \times 11\text{--}14.5 \mu\text{m}$ ($13.0 \pm 0.7 \times 12.5 \pm 0.7 \mu\text{m}$ ($n/2=90$), length/width ratio 1.04, light to middle purplish brown; spore wall reticulate, muri livid purple, the bottom of the meshes light yellowish brown, (5-) 6-7 (-8) meshes per spore diameter, meshes irregularly hexagonal or pentagonal, (1.5-) 2-2.5 (-4) µm long, (17-) 19-22 (-23) muri in the spore circumference at median view, muri 1-2 (-2.4) µm high; in SEM the meshes usually with a well developed, hemispherical or elongated protuberance on the bottom.

SPECIMENS EXAMINED — JAPAN: Kyushu, Fukuoka Pref., YOSHIKAWA-MURA, in the seeds of *Moehringia trinervia* var. *platysperma* (Maxim.) Makino (*M. platysperma* Maxim.), 7 May 1938, Y. Maki (TNS-F 243 892, holotype; SAPA – isotype).

Known distribution: only from the type collection.

Comments—*Haradaea moehringiae* was originally described as possessing purplish black spore mass (see also Vánky 1998: 46) and verruculose-reticulate spores. The colour of the spore mass seems to be purplish brown and definitely not dark enough to be considered as purplish black. The wall ornamentation is reticulate, as it has been corrected by Vánky (1998). The well developed

protuberance on the bottom of the meshes is noteworthy (Fig. 2). Spores were very rarely up to 16 µm and they were not taken into consideration.

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Preliminary check list of *Albuginales* and *Peronosporales* (*Chromista*) reported from the Iberian Peninsula and Balearic Islands

GEMA GARCÍA-BLÁZQUEZ¹, OVIDIU CONSTANTINESCU²,
M. TERESA TELLERÍA¹ & MARÍA P. MARTÍN¹

¹gemagarcia@rjb.csic.es

Real Jardín Botánico, C.S.I.C.

Plaza de Murillo 2, E-28014 Madrid, Spain

²ovidiu.constantinescu@evolvemuseum.uu.se

Botany Section, Museum of Evolution, Uppsala University

Norbyvägen 16, SE-752 36 Uppsala, Sweden

Abstract—The scrutiny of ca. 188 publications issued between 1867 and 2005 revealed that ca. 1500 fungus/host combinations of white rusts and downy mildews (*Albuginales* and *Peronosporales*) have been reported from Iberian Peninsula and Balearic Islands. The fungi belong to 13 genera and 101 species, and are parasitic on 266 plants belonging to 146 genera and 32 families. The hosts represent about 3.3 % of the total number of plants known from this territory. It is concluded that the probable number of fungi belonging to these two orders should be sensibly higher in this area, and that more collecting is necessary. The complete list can be accessed at: <http://www.mycotaxon.com/resources/weblists.html>

Key words—Andorra, Portugal, Spain, occurrence, *Peronosporomycetes*

Introduction

The records of *Albuginales* (white rusts) and *Peronosporales* (downy mildews) reported from the Iberian Peninsula and Balearic Island are scattered over nearly 200 publications issued between 1867 and 2005. The first record seems to be that of *Albugo candida* by Colmeiro (1867). Major contributions and/or preliminary lists for Portugal (Traverso & Spessa 1910; Câmara et al. 1936; Câmara & Oliveira 1944; Lucas & Dias 1976; Lucas et al. 1982) and Spain (González Frago 1916; Lázaro e Ibiza 1920) were also published, and the first list regarding the whole peninsula is due to González Frago (1924). A rather recent review, though incomplete and restricted to the genus *Peronospora*, is that by Gustavsson (1991).

The aim of this check-list is to provide a preliminary view of the presence and diversity of these fungi in the Iberian Peninsula including the Balearic Islands.

Materials and methods

Some 188 publications have been scrutinized. These include short or longer floristic reports, lists, but even papers dealing primarily with plant pathology aspects. A few references were not included because the information on the fungus and/or host was too vague.

The taxonomy and nomenclature of the fungi and the hosts are those considered correct by us at the moment when this list was edited. In many cases they differ from the names used in the original publications. Taking into account the preliminary character of this list, no cross-indexing for old-new names is provided.

For the taxonomy of various genera of fungi the following main sources have been used: *Albuginales* (Biga 1955; Choi & Priest 1995; Thines & Spring 2005), *Hyaloperonospora* (Constantinescu & Fatehi 2002; Göker et al. 2004), *Paraperonospora* (Constantinescu 1989), *Perofascia* (Constantinescu & Fatehi 2002), *Peronospora* (Gäumann 1923; Constantinescu 1991), *Plasmopara* (Kochman & Majewski 1970; Voglmayr et al. 2006), *Plasmoverna* (Constantinescu et al. 2005), and *Pseudoperonospora* (Waterhouse & Brothers 1981).

The taxonomy and nomenclature of the host plants follow Flora Iberica (Castroviejo et al. 1986-2003) and Flora Europaea (Tutin et al. 1964-1993). No authority names for fungal and host taxa are included. They can be found either in the sources mentioned above, or in the following on-line sites: Index fungorum (www.indexfungorum.org), CBS Utrecht (www.cbs.knaw.nl/databases/index.htm), Flora Europaea (<http://rbg-web2.rbge.org.uk/FE/fe.html>), and The International Plant Names Index (<http://www.ipni.org>).

Acronyms used: AND (Andorra), ESP (Spain), POR (Portugal). Name of provinces are those from Pando (1991).

Results

About 1500 individual, fungus/host combination records were available. The number and diversity of these fungi is summarized in Table 1.

Because the identity of both fungi and hosts was not checked against the specimens, some errors are unavoidable. Moreover, in the absence of deposited specimens, some records are and will remain doubtful.

Being based on literature records, and not on the examination of specimens, this list should be regarded only as a rough estimation of the *Albuginales* and *Peronosporales* occurring in the Iberian Peninsula. Future monographic studies will certainly alter the present situation.

It is estimated that ca. 8000 taxa of phanerogams are present in the flora of Iberian Peninsula and Balearic Islands. The number of hosts on which members

Table 1. Numbers of *Peronosporomycetes* and their hosts reported from from Iberian Peninsula and Balearic Islands.

FUNGI		NUMBER OF HOSTS ¹		
Genus	Number of species	Families	Genera	Infra generic taxa ²
<i>Albugo</i>	5	4	29	41
<i>Basidiophora</i>	1	1	1	1
<i>Bremia</i>	1	1	15	20
<i>Hyaloperonospora</i>	7	1	19	25
<i>Paraperonospora</i>	1	1	1	1
<i>Perofascia</i>	1	1	2	4
<i>Peronospora</i>	69	24	66	152
<i>Plasmopara</i>	7	5	10	14
<i>Plasmoverna</i>	1	1	3	3
<i>Pseudoperonospora</i>	4	3	4	5
<i>Pustula</i>	1	1	7	10
<i>Sclerospora</i>	1	1	1	1
<i>Wilsoniana</i>	2	1	2	2
TOTAL	101	32	146	266

¹ In several cases the same host may be parasitized by more than one fungus.

² Inclusive 11 subspecies and 9 hosts identified only to genus level.

of *Peronosporomycetidae* were recorded is ca. 266 (3.3 %). This percentage is low, particularly when compared with the situation from Romania, a smaller territory but with rather similar mixture of climatic conditions, in which more than 21% of the ca. 3000 plants are host of these fungi (Constantinescu & Negrean 1983). Undoubtedly, more collecting and taxonomic studies are necessary in order to get a more realistic picture of the presence of these fungi in the Iberian Peninsula and the Balearic Islands.

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Oidium perseae-americanae sp. nov. on avocado

J. R. LIBERATO ¹ & R. W. BARRETO ²

jose.liberato@dpi.qld.gov.au

¹ Department of Primary Industries & Fisheries, Plant Pathology Herbarium
80 Meiers Rd, Indooroopilly, Qld 4068, Australia

² Universidade Federal de Viçosa, Departamento de Fitopatologia
Viçosa, MG, 36571-000, Brazil

Abstract — *Oidium perseae-americanae* is described causing powdery mildew on avocado (*Persea americana*) in New Caledonia and Brazil.

Key words — *Erysiphaceae*, *Pseudoidium*, new species

Introduction

Avocado (*Persea americana*, *Lauraceae*) is an evergreen fruit tree, up to 20 m tall, native to Central America and widely cultivated in the tropics and subtropics. There have been occasional records of powdery mildews on avocado in the world literature (Ruehle 1958, Weber 1973, Menge & Ploetz 2003, Ohr et al. 2003), but strangely such reports refer to the etiological agent only as *Oidium* sp. Amano (1986) listed the geographical distribution of *Oidium* sp. on avocado as South and Central America, Africa, USA and Israel, but this author did not provide any references or details for these records. The names *Oidium perseae* Noack (Junqueira et al. 2002) and *Oidium persicae* (Wellman 1972, Mendes et al. 1998) appear in the literature for the fungus causing powdery mildew on avocado. However, the original publications for these two names could not be traced in the main lists of published fungal names as well as in Braun (1987) and Noack (1898). It appears that these names are nomina nuda. An evidence for such a status for the name *O. perseae* is that Viégas (1961), who was known to be very meticulous regarding the citation of authors of fungal names, listed the name *O. perseae* without an author, in his list of South American fungi.

Specimens of the fungus on avocado collected in New Caledonia and Brazil were examined and recognized as belonging to an undescribed species belonging to the subgenus *Pseudoidium*. This new species is described below. Morphology of the fungus was examined on microscopic mounts in lactic acid.

Biometric data were obtained only from the examination of turgid structures and only mature conidia (those unattached to conidiophores) were measured.

Taxonomic description

Oidium perseae-americanae Liberato & R.W. Barreto nov. sp.

Figs. 1-5

MYCOBANK #: MB 510486

Maculae in foliis vivis *Mycelium* externum, hypophyllum, albidum. *Hyphae* steriles ramosae, septatae, hyalinae, flexuosae, 2.5–6.5 μm crassae. *Appressoria* lobata. *Conidiophora* ex hyphis sterilibus oriunda, erecta, cylindracea, hyalina, levia, non-ramosa, 0–2-septata, 45–75 $\times$ 6.5–10 μm , cellulis basalibus 27.5–50 μm longis, cellulis subsequentibus brevioribus 0–2. *Conidia* solitaria, hyalina, non septata, ovoidea, doliiformes vel cylindracea, 27.5–40 $\times$ 10–20 μm , longitudo/latitudo 1.5–3.2, tubis germinativis plerumque brevibus, non ramosis, appressoriis lobatis. Status teleomorphosis absens.

Etymology: from the host *Persea americana*

Habitat: in foliis *Persea americana* Mill.

SPECIMENS EXAMINED – New Caledonia, La Foa, Sud, on *Persea americana*, 29 Oct 2003, J.C Wright (**HOLOTYPE**: BRIP 45247); Brazil, Campinas, São Paulo, on *P. americana*, 2 June 1944, A.R. Teixeira (**PARATYPE**: IACM 4629); São Paulo, São Paulo, on *P. americana*, 23 June 1944, R.R. Yalowosky (IACM 4589).

On living leaves. *Mycelium* hypophyllous. Superficial *hyphae* branched, septate, hyaline, flexuous, 2.5–6.5 μm wide, mycelial appressoria lobed. *Conidiophores* produced from the external mycelium, cylindrical, hyaline, smooth, unbranched, 0–2-septate, 45–75 $\times$ 6.5–10 μm , foot-cells 27.5–50 μm long, followed by 0–2 shorter cells. Conidia formed singly, ovoid, doliiform or cylindrical, 27.5–40 $\times$ 10–20 μm , l/w ratio 1.5–3.2, aseptate, hyaline, smooth. One germ tube per conidium, up to 1 $\times$ the length of the conidium, ending in a lobed appressorium. Teleomorph: not found.

Discussion

Three additional specimens (IACM 142, 3985 and 4587), labelled as *Oidium* sp. on avocado, were also examined but were in poor condition, so it was not possible to identify them. *Oidium perseae-americanae* is the first species of powdery mildew described on avocado.

Six powdery mildew species have been recorded on plants of the family Lauraceae, namely *Erysiphe benzoin* (F.L. Tai) U. Braun & S. Takam. (= *Microsphaera benzoin* F.L. Tai), *Erysiphe blasti* (F.L. Tai) U. Braun & S. Takam. (= *M. blasti* F.L. Tai), *Erysiphe cinnamomicola* U. Braun & S. Takam. (= *M. cinnamomi* (L.S. Olive) U. Braun), *Erysiphe dabashanensis* (R.Y. Zheng & G.Q. Chen) U. Braun & S. Takam. (= *Uncinula dabashanensis* R.Y. Zheng & G.Q. Chen), *Erysiphe irregularis* (R.Y. Zheng & G.Q. Chen) U. Braun & S. Takam. (= *U. irregularis* R.Y. Zheng & G.Q. Chen) and *Oidium lauracearum* Graniti & U. Braun (Braun 1987, Graniti & Braun 1998, Zhen & Chen 1978). The anamorphs



Figs 1-5. *Oidium perseae-americanae* (bar = 20 μ m). Figs 1-2. Conidiophore and conidium (IACM 4583 and IACM 4629). Fig 3. Lobed hyphal appressorium (arrowed) (BRIP 47247). Fig 4. Germinated conidia (IACM 4629). Fig 5. Conidium (BRIP 47247).

of these five *Erysiphe* species have not been described. *E. cinnamomicola*, *E. dabashanensis* and *E. irregularis* are only known from the type collections. The first was observed on *Cinnamomum camphora* (L.) J. Presl and the latter two on *Litsea populifolia* (Hemsl.) Gamble. *E. benzoin* occurs on *Lindera glauca* Blume and *E. blasti* on *Lindera* spp., *Litsea* sp. and *Parabenzoin praecox* Nakai (Braun 1987). *O. lauracearum*, described on *Laurus nobilis* L., differs from *O. perseae-americanae* by having mycelial appressoria that are nipple-shaped, hyphae that vary from smooth to verruculose, longer conidiophores (50–120 μ m long), conidiophore cells that may be as long as the foot-cell, and longer conidia (25–50 $\times$ 12–20 μ m) smooth to rough-walled (Graniti & Braun 1998). Powdery mildews are mostly considered to be host specific. The subfamily *Erysiphoideae*, whose anamorphs belong to the genus *Oidium*, has two polyphagous compound species, namely *Golovinomyces cichoracearum* (DC.) V.P. Gelyuta and *Podosphaera fusca* (Fr.) U. Braun & Shishkoff s. lat. Unlike *Oidium perseae-americanae*, both species produce conidia in chains.

Therefore, we regard *O. perseae-americanae* to be a new species of *Erysiphaceae*, although seemingly widespread, as suggested by the disjunct records. There are no records of powdery mildews as relevant diseases of avocado. This may explain the fact that this fungal species remained neglected until now, although associated to an important crop species.

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***Urocystis chifengensis* sp. nov. (Urocystaceae)
from China**

LIN GUO¹ & TIEZHI LIU²

guol@sun.im.ac.cn

¹Key Laboratory of Systematic Mycology and Lichenology
Institute of Microbiology, Chinese Academy of Sciences
Beijing 100080, China

tiezhiliu@yahoo.com.cn

²Department of Life Science, Chifeng College
Inner Mongolia, Chifeng 024001, China

Abstract—A new species, *Urocystis chifengensis* on *Lepidium apetalum*, is described. The specimen was discovered in Chifeng of Inner Mongolia Autonomous Region, China. A key to the species of *Urocystis* on *Brassicaceae* is given.

Key words—*Ustilaginomycetes*, smut fungus, taxonomy

An *Urocystis* species on *Lepidium apetalum* was collected from Chifeng of Inner Mongolia Autonomous Region by the junior author. It is parasitic on the stems, not forming galls. The host plant belongs to the family *Brassicaceae*. So far, four species of the genus *Urocystis* on *Brassicaceae* have been reported, all causing root galls (Vánky 1991, Guo 2003a): 1) *Urocystis coralloides* Rostr. (Rostrup 1881); 2) *U. brassicae* Mundk. (Mundkur 1938); 3) *U. sophiae* Griffiths (Griffiths 1907) and 4) *U. yunnanensis* L. Guo (Guo 2003a). The newly collected species is quite different from the above four species by having sori in the stems, not forming root galls, and having few ustilospores (1–3) in the spore balls. The new species differs from *U. coralloides* on *Lepidium* by having larger spore balls (37–66.5 x 32.5–53 μ m) and only few sterile cells surrounding the ustilospores, or sterile cells are lacking. It is described as:

***Urocystis chifengensis* L. Guo & T. Z. Liu, sp. nov.**

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Figs. 1–4

Sori in caulibus, usque ad 10 mm longi, primum membrana cinereo-argentea cooperti, deinde expositi. Massa sporarum nigra, pulverulenta. Glomeruli sporarum subglobosi, ellipsoidei, ovoidei vel irregulares, 37–66.5 x 32.5–53 μ m, e ustilosporis 1–3 constructi, cellulis sterilibus nonnullis vel nullis circumdati. Ustilosporae subglobosae, ellipsoideae,

ovoideae vel leviter irregulares, 32–49 x 29.5–46.5 μm , *atrobrunneae*; pariete (1–)2–3.5 μm *crasso*, *superficie levi* sub LM, *minute et dense verruculoso* sub SEM. *Cellulae steriles subgloboseae, ellipsoideae vel elongatae*, 11–30 x 7.5–22 μm , *brunneae vel hyalinae*; pariete *ca.* 0.5–1 μm *crasso, levi*.

Sori on stems, up to 10 cm long, at first covered by a grayish-silvery membrane, later becoming exposed. Spore mass black, powdery. Spore balls subglobose, ellipsoidal, ovoid or irregular, 37–66.5 x 32.5–53 μm , composed of 1–3 ustilospores, surrounded by a few sterile cells or lacking. Ustilospores subglobose, ellipsoidal, ovoid or slightly irregular, 32–49 x 29.5–46.5 μm , dark brown; wall (1–)2–3.5 μm , surface smooth as seen by LM (light microscopy), minutely and densely verruculose as seen by SEM (scanning electron microscopy). Sterile cells subglobose, ellipsoidal or elongated, 11–30 x 7.5–22 μm , brown or hyaline; wall *ca.* 0.5–1 μm thick, smooth.

On *Lepidium apetalum* Willd. (*Brassicaceae*), Inner Mongolia: Chifeng, Hongshan District, Dasanjia, 21 VI 2003, T.Z. Liu 262, HMAS 143932 (holotype), HUV 21381 (isotype).

Key to the species of *Urocystis* on *Brassicaceae*

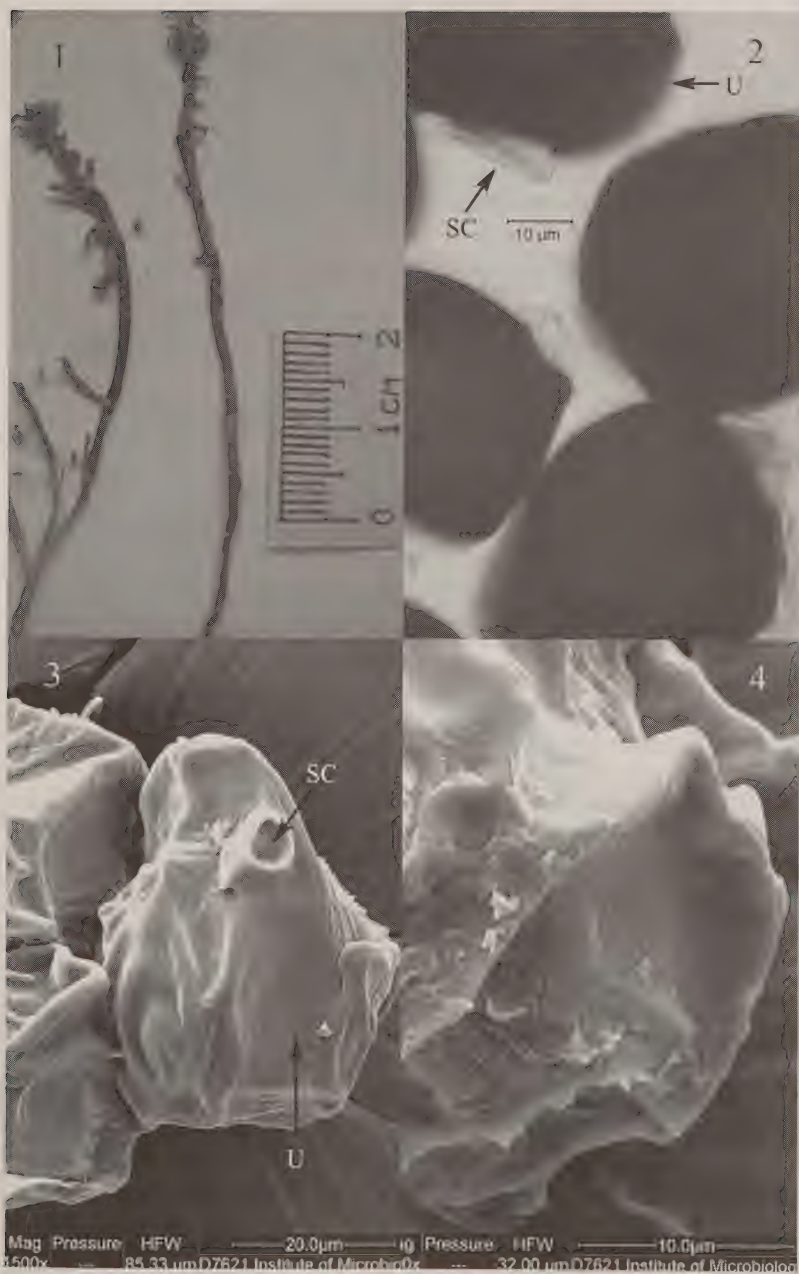
1. Sori on stems, not forming galls *U. chifengensis*
1. Sori on roots as galls 2
 2. Ustilospores per spore ball often more than 8 *U. yunnanensis*
 2. Ustilospores per spore ball always less than 9 3
3. Ustilospores per spore ball 1–6(–8) *U. brassicae*
3. Ustilospores per spore ball 1–5 4
 4. Sterile cells thin-walled (1–2 μm) *U. sophiae*
 4. Sterile cells thick-walled (1.5–4 μm) *U. coralloides*

In China, so far 48 *Urocystis* species have been reported of which 3 occur on *Brassicaceae* (Wang 1963, Tai 1979, Guo 1991, 1992, 1993, 1997, 1998, 1999, 2001, 2002a, b, 2003a, b, 2005, 2006, Guo & Xi 1989, Guo & Zhang 2004, 2005, Vánky 2004, Vánky & Guo 1986, Yang et al. 2007).

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Figs. 1–4. *Urocystis chifengensis* on *Lepidium apetalum* (HMAS 143932, holotype); Fig. 1. Sori; Fig. 2. Spore balls, ustilospores (u, arrowhead) and sterile cells (sc, arrowhead) as seen by LM; Figs. 3–4. Spore balls, ustilospores (u, arrowhead) and sterile cells (sc, arrowhead) as seen by SEM.



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Lepiotaceous fungi in California, U.S.A. – 1. *Leucoagaricus amanitoides* sp. nov.

ELSE C. VELLINGA^{1*} & R. MICHAEL DAVIS²

*vellinga@nature.berkeley.edu or ecvellinga@comcast.net

¹Department of Plant and Microbial Biology, University of California at Berkeley,
Berkeley, CA 94720-3102, U.S.A.

²Department of Plant Pathology, University of California at Davis,
Davis, CA 95616, U.S.A.

Abstract — A new, white *Leucoagaricus* species is described from central California. *Leucoagaricus amanitoides* is characterized by a volvate, short and bulbous stipe, long narrowly clavate cystidia and ellipsoid spores without a germ pore.

Key words — biodiversity, Agaricales, Central Valley

Introduction

The *Leucoagaricus/Leucocoprinus* clade in the *Agaricaceae* is represented by many species in California (Vellinga 2004a, b), with a considerable number still undescribed. A striking white species, resembling a short-stiped *Amanita* species, was discovered in Davis (Yolo Co.), and is here described as new in the genus *Leucoagaricus* Singer.

The genera *Leucoagaricus* Singer, *Leucocoprinus* Pat. and *Sericeomyces* Heinem. form one monophyletic clade within the family *Agaricaceae* (Vellinga 2004a). The molecular data on which this conclusion is based, support, though weakly, a monophyletic *Leucocoprinus*, embedded within *Leucoagaricus*, rendering that genus paraphyletic. *Sericeomyces* is polyphyletic. Preliminary data on protein coding gene sequences confirm that *Leucoagaricus* and *Leucocoprinus* form one, monophyletic, clade (non published results, ECV).

The type species of *Leucoagaricus*, *L. macrorrhizus* Locq. ex E. Horak, (synonym *L. barssii* (Zeller) Vellinga), does not have close relatives and is morphologically different from all other species analysed, so its position within the genus and the clade is not yet final (Vellinga 2004a).

Morphologically, *Leucoagaricus* is characterized by the following combination of characters: metachromatic spores, absence of clamp-connections, absence of pseudoparaphyses around the basidia, and a pileus which is not or hardly

plicate in the outer zone (Singer 1986; Vellinga 2001). *Leucocoprinus* shares the metachromatic spores and the absence of clamp-connections, but does have pseudoparaphyses around the trimorphic basidia, and a plicate pileus.

Despite these morphological differences between *Leucoagaricus* and *Leucocoprinus*, several species have been placed in both genera, e.g. *L. americanus* (Peck) Vellinga and the other reddening species like *L. badhamii* (Berk. & Broome) Singer (compare Reid 1990 and Vellinga 2001).

If the *Leucoagaricus/Leucocoprinus* clade were recognized as one genus, this would be an enormous genus and many new combinations would have to be made, since *Leucocoprinus* is the older name (Patouillard 1888; see e.g. Vellinga 2004a). This step may be premature, since it is likely that the clade can be split into smaller monophyletic and morphologically uniform groups which can be recognized at the genus level. The inclusion of further species from the large number in the tropics that are presently undescribed, combined with data from a wider range of genes, will surely clarify the division of the clade into distinct genera. Pending this research, a conservative approach is adopted here. The new species with characters in concordance with the old concept of *Leucoagaricus* will be accommodated in that genus.

The *Leucoagaricus* species described here was found under redwood (*Sequoia sempervirens*) and Valley oaks (*Quercus lobata*), pushing up through heavy clay, in the arboretum of the University of California at Davis. This arboretum is a half-natural area alongside a creek, where various California native trees and a number of exotics are planted among original Valley oaks. As the Davis campus lies in an area which is mycologically virtually unexplored, the vast Central Valley of California, the species could be a California native or an exotic brought in with plant material from elsewhere. The species fruits regularly in December/January.

Materials and methods

Standard methods for describing the basidiocarps were applied, using the terminology of Vellinga (2001). The notation [84, 5, 4] indicates that measurements were made on 84 spores in five samples in four collections. The following abbreviations are used: avl for average length, avw for average width, Q for quotient of length and width and avQ for average quotient.

Taxonomic description

***Leucoagaricus amanitoides* R.M. Davis & Vellinga sp. nov.**

Figures 1-3

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Leucoagaricus amanitoides basidiocarpis albis, stipite volvato bulboso brevi, cheilocystidiis longis anguste clavatis, sporis inamyloideis sine poris, fibularum absentia designatus.

Holotypus: 'U.S.A., California, Yolo Co., Davis, University of California Davis Arboretum, 7 January 2006, R.M. Davis (coll. E.C. Vellinga 3456) (UC)'.



Fig. 1: *Leucoagaricus amanitoides*, basidiocarp from holotype (photo by R.M. Davis)

Etymology: amanitoides is derived from the Greek 'αμανιτοειδης' = 'looking like an *Amanita*', because of the striking resemblance to some members of that genus.

Basidiocarp when young with a small hemispherical pileus sitting on top of a turbinat stipe.

Pileus 35 mm when young, expanding to 85 mm, when young hemispherical with flat top, later expanding to plano-convex, wavy applanate with low wide umbo or with applanate centre, white in all stages, but when old with brown patches, dry, slightly radially squamose-fibrillose with short fibrils, when young with thick involute margin, later straightening out, but still exceeding lamellae. **Lamellae**, L = about 105, l = 0 or 1, free, rather crowded, not or slightly ventricose, segmentiform, up to 9 mm wide, in some specimens

lamellulae anastomosing with lamellae, slightly cream to cream coloured when seen from aside, with distinctly white cystidiose, irregular or even scalloped edge. **Stipe** 32-90 x 11-20 mm, with amorphous bulbous base with turbinate or rounded bottom, up to 35 mm wide in young specimens, 30 mm in mature specimens, white-cream, smooth and shiny with up to 3 bands of guirlandes of white velar material on the stipe, with some white velar remnants at top of bulb, solid, or narrowly hollow. **Annulus** small and triangular in cross-section, white. Velum universale soft and white. **Context** in pileus very thick, white and dull, not changing colour; in stipe white, slightly glassy in outer part. **Smell** (of cut specimen) sweet and pleasantly fungoid, but slightly astringent at back of throat. **Taste** indistinctly fungoid.

Basidiospores [84, 5, 4] in side view 6.1-8.3 (8.8) x 4.1-5.4 μm , $\text{avl} \times \text{avw} = 6.7\text{--}7.5 \times 4.6\text{--}5.0 \mu\text{m}$, $Q = 1.27\text{--}1.79$, $\text{av}Q = 1.43\text{--}1.51$, most ellipsoid, some oblong, some slightly amygdaloid in side-view, in frontal view ellipsoid or slightly oblong, not-coloured, thick-walled, without germ pore, with oil drop, congophilous but variable, either only the young ones, or all, dextrinoid, and vaguely metachromatic in Cresyl blue. **Basidia** 30-39 x 8.5-10 μm , 4 spored, without basal clamp connection. **Lamella edge** sterile. **Cheilocystidia** 29-75 x (6-)8-15 μm , narrowly clavate, often slightly capitate, rarely moniliform or narrowly lageniform, not-coloured, and slightly thick-walled. **Pleurocystidia** not observed. **Pileus covering** a loosely arranged cutis of cylindrical, colourless hyphae, 3-7 μm in diameter, with terminal elements slightly inflated and up to 12 μm wide. **Lamella trama** regular. **Stipe covering** a cutis of loosely arranged slightly inflated to cylindrical colourless hyphae, around 5-10 μm wide. **Clamp connections** absent.

Habitat and distribution – Solitary to gregarious, under planted *Sequoia sempervirens*, other conifers and *Quercus lobata* on heavy clay, December-beginning of January, only known from the type locality, an arboretum, in Davis, California (U.S.A.).

Collections examined — U.S.A., CALIFORNIA: Yolo Co., DAVIS, UNIVERSITY OF CALIFORNIA AT DAVIS ARBORETUM, 3.I.2003, R.M. Davis 03001 (herb. R.M. Davis) (Genbank nrITS EF080870; nrLSU EF080872); *ibidem*, 17.XII.2004, E.C. Vellinga 3331 (UC) (Genbank nrITS EF080869; nrLSU EF080873); *ibidem*, 19 Dec. 2004, R.M. Davis (herb. R.M. Davis) (Genbank nrITS EF080871); *ibidem*, 7.I.2006, R.M. Davis (coll. E.C. Vellinga 3456; HOLOTYPE UC).

Comments — In the field the species resembles most closely an *Amanita* species, but the spores are dextrinoid and not amyloid, and the hymenophoral trama is regular, not divergent.

The closest relatives to this new species are, according to phylogenetic analyses of nrITS and nrLSU sequences (see examined collections for GenBank accession numbers), species cultivated by attine ants in cultivar clade 1 in the

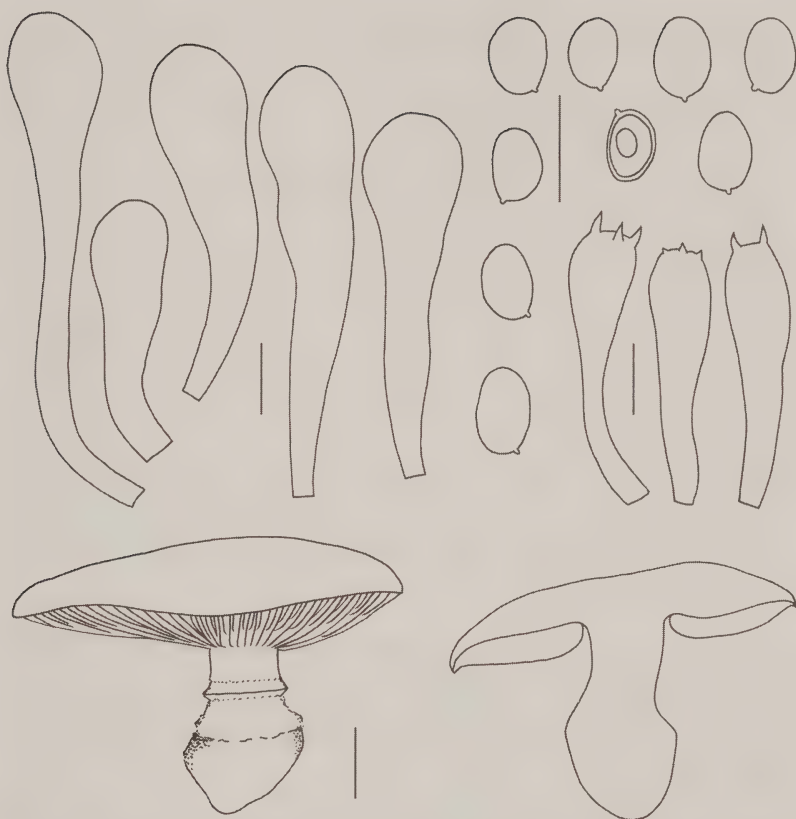


Fig. 2: *Leucoagaricus amanitoides*, basidiocarp (ecv3331), spores (ecv3456), basidia (rmd03001) and cheilocystidia (ecv3456). Scale bar is 1 cm for basidiocarp and 10 μ m for microscopic features.

analyses by Mueller et al. (1998). *Leucoagaricus amanitoides* has a combination of striking characters: it is completely white, has a volva, and a bulbous stipe base, and microscopically, the spores lack a germ pore, cheilocystidia are narrowly clavate and long, and pleurocystidia are lacking. We compared our species with others from the literature which either share the presence of a volva, are white and fleshy, or in other respects resemble *Amanita* species. A short discussion of those species follows.

The two white European volvate species, *Leucoagaricus subvolvatus* (Malençon & Bertault) Bon and *Leucoagaricus volvatus* Bon & A. Caball. belong to sect. *Rubrotincti* Singer. The former has been included in molecular

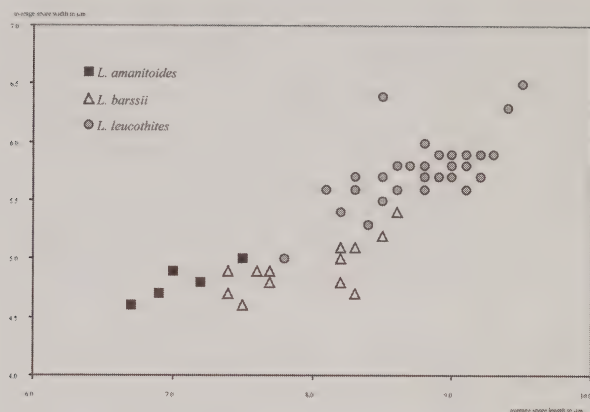


Fig. 3: Scatter diagram of average spore sizes for *Leucoagaricus amanitoides*, *L. barssii* and *L. leucothites*. The measurements for *L. barssii* are based on 14 collections from Europe, western North America (including the type collection) and Australia; those for *L. leucothites* are based on 33 collections from Europe, North America and Australia. Average spore length on the X-axis, average spore width on the Y-axis.

phylogenetic studies (Vellinga 2004a) and is close to *Leucoagaricus crystallifer* Vellinga and *L. menieri* (Sacc.) Singer, and other white species with crystals on top of the cheilocystidia. *Leucoagaricus volvatus* has some olivaceous tinges in the pileus, but also has crystals on the cystidia and a slightly gelatinized pileus covering.

Two other volvate species are *Leucoagaricus bivelatus* B.P. Akers & Ovrebo from Panama and *Lepiota volvatula* Pegler from the Caribbean island of Martinique. The former has slender basidiocarps with a sheathing volva, and a bluish black pileus; the spores are ellipsoid, lacking a germ pore, and the cheilocystidia are relatively short and narrowly clavate (Akers & Ovrebo 2005). The latter is a small species (pileus 2.5-3 cm), with a thin and fragile, brownish pileus, which is sulcate-plicate; the spores are 5.5-7.2 x 3.5-4.5 µm (Pegler 1983).

Fleshy white or whitish species that show some resemblance to the new species are *Leucoagaricus leucothites* (Vittad.) Wasser and *L. barssii*. *Leucoagaricus leucothites* is a common species of open man-made habitats, such as lawns and fields. There is no volva at the base of the stipe, the spores have a germ pore and the pileus covering is a trichoderm. The spores are bigger than those of *L. amanitoides* (Fig. 3). *Leucoagaricus leucothites* is widespread and has been recorded from Europe, Asia, North America, Africa and Australia (see Vellinga 2004b and references therein).

Leucoagaricus barssii also occurs in man-made habitats, but has a radially fibrillose, white to greyish pileus covering, and a tapering stipe. The ellipsoid spores lack a germ pore, and pleurocystidia are present close to the lamella edge (Vellinga 2000, 2001). The spore sizes overlap with those of *L. amanitoides* (Fig. 3). This species is widespread and known from Europe, North America and Australia (e.g. Vellinga 2000, 2001, and personal observations).

Leucoagaricus gaillardii Bon & Boiffard resembles *L. amanitoides* in its sturdiness; it is a species with a pinkish pileus, a distinctly bulbous stipe, which can be volvate. The spores measure 7-9(-10) x 5-6(-7) μm . The cheilocystidia are narrowly lageniform to cylindrical and wavy, and not narrowly clavate as in *L. amanitoides*, but they are of the same length (Bon & Boiffard 1975). *Leucoagaricus gaillardii* grows in sandy habitats in south-western Europe. Its phylogenetic position is not quite clear; it has been originally described in section *Rubrotincti* (Bon & Boiffard 1975), but on account of the reddening of the pileus centre when touched, and the green reaction in ammonia it was placed in sect. *Piloselli* (Kühner) Singer (Priou et al. 1995). One of us (ECV) has examined one collection from France, and its nrITS1 sequence groups with those of species in section *Rubrotincti* (data not shown).

Several other species resemble *Amanita* species, but differ from *L. amanitoides* in the colours of the basidiocarps; these are discussed here briefly in alphabetical order.

Lepiota amanitifformis Murrill was described from conservatories of the New York Botanical Garden. Its pileus surface is dry, and reddish brown, the stipe very short and thick, usually tapering upward from an abrupt, globose bulb at the base, white or tinged with reddish-brown (Murrill, 1914).

Lepiota amanitoides Beeli, with dingy white pileus with yellowish stains, and a bulbous stipe base, turned out to be an *Amanita* species (Bas 1969).

Lepiota subamanitifformis S. Imai from Hokkaido (Japan) has a red-brown pileus, and the margin of the annulus is given as 'incarnate' (Imai 1938).

Lepiota subamanitifformis Dennis is characterized by a pale brown pileus with darker umbo, and was described from Trinidad (Dennis 1952).

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Lepiotaceous fungi in California, U.S.A. – 2.

Lepiota rhodophylla sp. nov.

ELSE C. VELLINGA

ecvellinga@comcast.net or *vellinga@nature.berkeley.edu*

Department of Plant and Microbial Biology, University of California at Berkeley,
Berkeley, CA 94720, U.S.A.

Abstract — A new *Lepiota* species with spurred spores and a pileus covering made up of repent hyphae is described from a *Cupressus macrocarpa* stand in central coastal California. Thick pinkish lamellae and sturdy pink-lilac brown basidiocarps are striking macroscopical characters of this species.

Key words — biodiversity, native forest, *Agaricaceae*, steno-spored species

Introduction

Stands of *Cupressus macrocarpa* and of *Sequoia sempervirens* in coastal California are rich in lepiotaceous species (white-spored members of the family *Agaricaceae*) (e.g. Vellinga 2004; Sundberg 1971, 1989; Largent 2000), though many have not been recognized as separate species in the past (e.g. the species of *Leucoagaricus* sect. *Rubrotincti*). A high number of these species may grow together in a small area, such as a single Monterey cypress stand in the San Francisco Watershed (Vellinga 2004), where 25 species were encountered in the 2002/2003 mushroom season. Reasons for this phenomenon may be found in the absence of competition from ectomycorrhizal fungi, temporal differences in growth optimum for the species involved, and specialization to different micro-habitats by individual species (see also Vellinga 2004).

During fieldwork in this area in the mushroom seasons of 2000 and 2002/2003 a striking *Lepiota* species with pink lamellae was found. It is here described as new.

Materials and methods

Standard methods for describing the basidiocarps were applied, using the terminology of Vellinga (2001). Colour annotations in the macroscopical descriptions are from Munsell soil color charts (1975). The notation [80, 5, 5]

indicates that measurements were made on 80 spores in five samples in five collections. Spores were measured in Congo Red in ammonia. The length of the spores is measured from bottom of spur to top of spores; the width of the spores is measured in the middle of the spore, excluding the spur. In other words, the spur is included in the length of the spores, but excluded from the measurements of the width. The following abbreviations are used: avl for average length, avw for average width, Q for quotient of length and width and avQ for average quotient.

Taxonomic description

Lepiota rhodophylla Vellinga sp. nov.

Figures 1-2

MYCOBANK MB 510368

Lepiota boudieri Bres. *affinis*; *basidiocarpa valida*; *pileus pallide roseobrunneus*, *vel purpuraceobrunneus*; *lamellae crassae*, *roseolae*.

Holotypus: 'U.S.A., California, San Mateo County, San Francisco Watershed, Monterey cypress grove, 28 January 2003, E.C. Vellinga 3026 (UC)'.

Etymology: The epithet 'rhodophylla' is derived from the Greek 'ροδοφυλλος', pink leaf, because of the striking pink lamellae.

Pileus 27-68 mm, irregularly convex with deflexed to involute margin when young, wavy applanate plano-convex later, with low umbo to plano-concave in older specimens, completely felted-tomentose, either completely closed or in small patches, not distinctly discreetly squamose, sometimes radially fibrillose at margin, variable in colour, pale pinkish brownish (like 5 YR 7/4-8/4) all over, or rather dark brown (7.5 YR 4-3/4, 5 YR 5/4 to 6/4 around centre), and paler at margin to pinkish-greyish or beige (like 5YR8-7/2-3), in some places showing white context, but orange where damaged; margin when young thick, pale pinkish, and cottony, exceeding lamellae. **Lamellae**, L = 55-70, l = 0-3, moderately crowded, free, often almost emarginate, rather thick, segmentiform to ventricose up to 6 mm wide, pink, pale brownish, pinkish beige or pale pinkish (10 YR 8/4, 7.5 YR 7/4, 5 YR 6/4, 5 YR 7/4, 5 YR 8/3-4, sometimes with touches of 5 YR 6/4), with white irregular cystidioid edge or with concolourous even edge. **Stipe** 38-65 x 7-15 mm, sturdy, cylindrical or, rarely, compressed, sometimes slightly narrower at base, pale pink and distinctly lilac pink or pale lilac pink at apex, with colour as on pileus lower down, longitudinally innately striate-fibrillose in upper 1/3, in lower 2/3 when young with distinct bands or girdles and tufts of material as on pileus, later less clearly so, and more woolly, when young with annulus-like structure, with white rhizomorphs at base, hollow. **Context** whitish in pileus and pinkish just above the lamellae, orange around maggot holes; pinkish or lilac in stipe apex to cream at bottom, with white pith, brown discoloured at utmost base. **Smell**



Fig. 1: *Lepiota rhodophylla*. Basidiocarps, spores, basidia, cheilocystidia and pileus covering elements. All from ecv3026, except * from ecv2972 and ** from ecv2610.

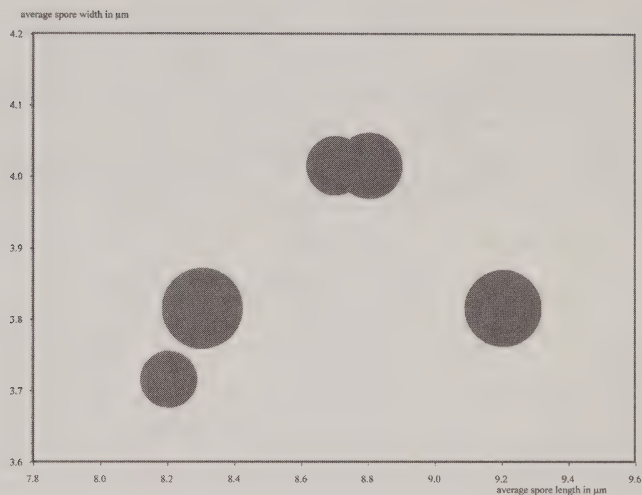


Fig. 2: *Lepiota rhodophylla*: average spore sizes per collection; the size of the bubble is an indication of the maximum size of the cheilocystidia, varying from 23 to 41 μm .

variable, from vaguely rubber-like, i.e. like the smell of *L. cristata* (Bolton :Fr.) P. Kumm. to very strongly so, but without the sweet component. **Taste** and **spore print** colour unknown. KOH on pileus surface yellow.

Basidiospores [80, 5, 5] 7.6-10.0 x 3.3-4.2 μm , avl x avw = 8.2-9.2 x 3.7-4.0 μm , Q = 2.0-2.7, avQ = 2.2-2.45, in side-view subcylindrical, with (but not always) broad straight or outgrown spur, in frontal view subcylindrical, slightly thick-walled, with one guttule, dextrinoid, congophilous, not metachromatic in Cresyl blue. **Basidia** 23-35 x 6.5-8.5 μm , 4-spored, with basal clamp connection. **Lamella edge** sterile. **Cheilocystidia** 16-41 x 7.0-16 μm , clavate, broadly clavate or narrowly clavate, varying in size between collections, e.g. 20-30 μm long in collection ecv2992, and 23-40 μm long in collection ecv2610. **Pleurocystidia** absent. **Pileus covering** a cutis with adnate hyphae, made up of up to 5-6 pigmented elements, with terminal cells, 56-120 x 8-16 μm , tapering towards apex; clamp connections present at all septa; pigment intracellular light purple brown, sometimes granular, soluble in ammonia. **Stipe covering** a cutis of cylindrical, straight hyphae, 3-7 μm in diameter; in lower 2/3 of stipe patches made up of repent hyphae, as on pileus. **Clamp connections** present at all septa.

Habitat and distribution – Gregarious in small groups, only known from one locality in central coastal California, terrestrial in an almost 100 yr old *Cupressus*

macrocarpa plantation on an east-facing slope, close to a small seasonal creek. December-end of February.

Collections examined — U.S.A., CALIFORNIA: San Mateo Co., SAN FRANCISCO WATERSHED, 8.XII.2000, E.C. Vellinga 2610 (Genbank nrITS AY176480); *ibidem*, 23.XII.2002, E.C. Vellinga 2972; *ibidem*, 7.I.2003, E.C. Vellinga 2992; *ibidem*, 28.I.2003, E.C. Vellinga 3026 (Holotype; Genbank nrITS EF080864); *ibidem*, 25.II.2003, E.C. Vellinga 3049 (all in UC).

Comments — At first sight, *Lepiota rhodophylla* can be taken for an *Agaricus* species, because of the strikingly pink lamellae. However, the absence of brown spores, and the presence of white spurred spores and clamp connections make identification as a *Lepiota* species easy. The present author knows no *Lepiota* species with which it can be confused. The combination of its robustness and the pink lamellae is unique. *Lepiota andegavensis* also has sturdy basidiocarps, but the pileus is dark brown, and the stipe and lamellae are strikingly white (Mornand 1983, Chalange 1995).

There is intraspecific variation in the colour of the basidiocarps, and in the length of the spores and cheilocystidia. There does not seem to be any correlation between spore length and cystidium length (fig. 2). The two collections represented by the nrITS sequences in Fig. 3 exhibit differences in colour, ecv2610 being dark, and ecv3026 pale pink.

Lepiota rhodophylla groups together with *L. boudieri* Bres. in a maximum likelihood analysis of nrITS data in a wide sampling of *Lepiota* species (Clade I in fig. 3). *Lepiota rhodophylla*, *L. boudieri* and the others in this clade are characterized by spurred spores, and repent, clamped hyphae on the pileus covering (see also Vellinga 2003). The sister group to this clade has also spurred spores, but the pileus covering is made up of erect elements, with septa lacking clamp connections (Clade II in fig. 3).

One species, *Lepiota andegavensis* Mornand (1983), is an enigma in morphological and molecular-phylogenetic aspects. Bon (1993) described its pileus covering as a cutis, resembling that of *L. rhodophylla* and *L. boudieri*, but Vellinga (2001) who studied his collection concluded it was closer to that of *L. castanea* Quél., i.e. with septate but clampless elements. Parsimony analyses of the nrITS sequences group *L. andegavensis* with *L. boudieri* and *L. rhodophylla*, but in the Maximum Likelihood analyses it is basal to all spurred spored (stenospored) species.

The sister group to all stenospored species is morphologically characterized by ellipsoid spores and long cells in the pileus covering (Vellinga 2003). This group, comprising *L. subincarnata* J.E. Lange and *L. brunneoincarnata* Chodat & C. Martin, is infamous due to the occurrence of α - and β -amanitines in the basidiocarps, though these substances have also been reported in the stenospored *L. castanea* (Gérault & Girre 1975).

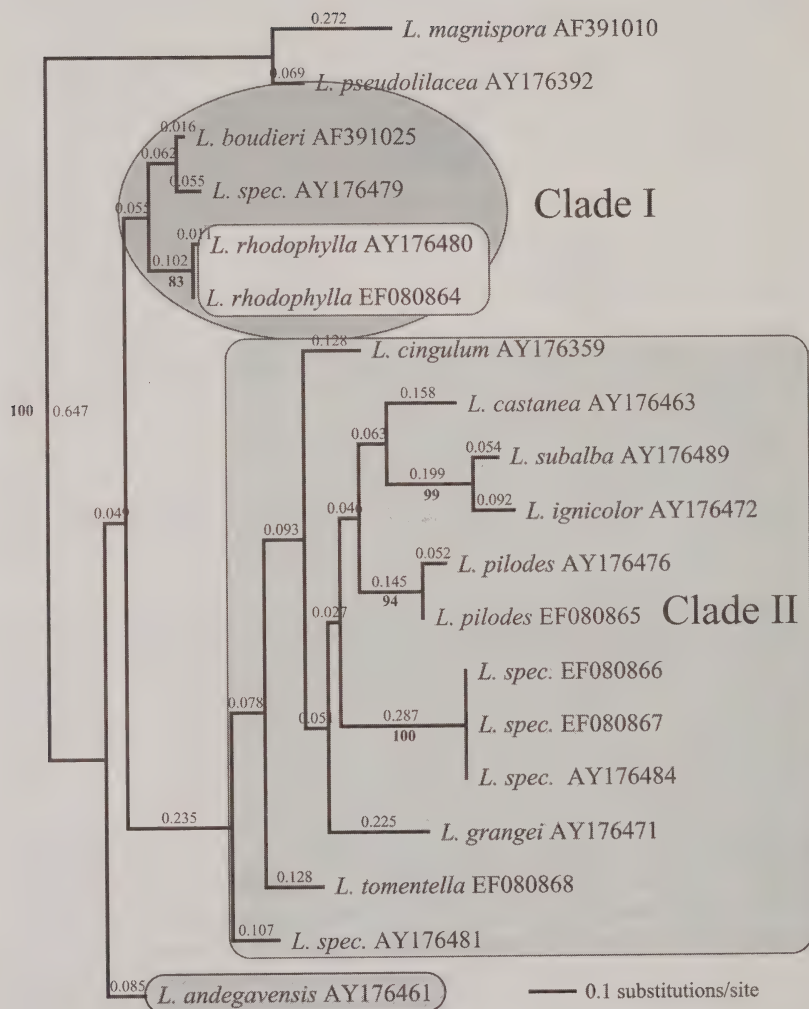


Fig. 3: Phylogenetic relationships of *Lepiota* species with spurred spores and a pileus covering made up of long elements, based on a Maximum Likelihood analysis of nrITS sequences under the HKY85 model. Bootstrap values in bold are based on 100 replicates. Genbank accession numbers are given for each collection. The topology of a tree based on Maximum Parsimony analysis is identical, except for the position of *L. andegavensis* which belongs to Clade I in the MP analysis. *Lepiota magnispora* Murrill and *L. pseudolilacea* Huijsman, with a trichodermal pileus covering with both long elements, and short, clavate elements at the base of these long elements, are used as outgroup.

Acknowledgments

The San Francisco Public Utilities Commission granted permission to inventory the cypress groves of the San Francisco watershed area (west of Crystal Spring Reservoir) and many thanks to Bill & Louise Freedman for organizing this and accompanying us. Jan-Frits Veldkamp was so kind as to correct the Latin diagnosis. John Lennie helped with field work and edited the text. Comments on an earlier version by Dr. Brian A. Perry and Prof. Zhu-Liang Yang were very helpful. Partial funding by National Science Foundation grant DEB 0618293 is gratefully acknowledged.

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Lepiotaceous fungi in California, U.S.A. – 3. Pink and lilac species in *Leucoagaricus* sect. *Piloselli*

ELSE C. VELLINGA

vellinga@nature.berkeley.edu or ecvellinga@comcast.net

Department of Plant & Microbial Biology, University of California at Berkeley, Berkeley,
CA 94720-3102, U.S.A.

Abstract – Type collections of two beautiful pink and lilac agarics, viz. *Lepiota roseolivida* and *L. decorata*, are studied, and descriptions based on many fresh collections from California are given. *Leucoagaricus marriagei* is considered a synonym of *L. roseolivida*, based on morphology and ITS sequences, and *Leucoagaricus idae-fragum* is placed in synonymy with *L. decorata*. Based on morphology and molecular data, these species belong to the *Leucoagaricus/Leucocoprinus* clade in the *Agaricaceae*. Morphologically, they are placed in *Leucoagaricus* sect. *Piloselli*. However, nomenclatural changes are not made at this moment, as there are uncertainties over generic circumscriptions within the clade.

Key words – biodiversity

Introduction

California is rich in species in the *Leucoagaricus/Leucocoprinus* clade of the *Agaricaceae* (Vellinga 2004a, b), many of which are new to science. Murrill on his 1911 trip to the west coast of North America (Murrill 1912) collected and later described several new species, of which *Lepiota roseolivida* from Muir Woods, north of San Francisco, is the most beautiful. *Lepiota decorata* (Zeller 1922, 1929) is also a striking species, originally described as *L. pulcherrima*, from central western Oregon, which is also found in California.

Descriptions of the microscopical details of the type collections, and full descriptions based on recent collections are given here.

Based on the morphological characters of these species, both belong to *Leucoagaricus* sect. *Piloselli* (Kühner) Singer, a group of species whose basidiocarps turn red, when they are scratched, and parts turn green in ammonia vapours (see also Vellinga 2004b for phylogenetic placement based on nrITS and nrLSU sequences). The taxonomy of the *Leucoagaricus/Leucocoprinus* clade in the *Agaricaceae* is still in flux (Vellinga 2004b), with the main question whether it is one genus, *Leucocoprinus* Pat., or whether it can be split up into several

smaller morphologically well-defined genera. Awaiting further research on tropical species, and the outcome of multigene phylogenetic analyses, *Lepiota roseolivida* and *L. decorata* are provisionally retained in the genus *Lepiota*, despite the fact that both species clearly do not belong there.

Methods

Standard methods for describing the basidiocarps were applied, using the terminology of Vellinga (2001). Colour annotations in the macroscopical descriptions are from Kornerup & Wanscher (1974) and Munsell soil color charts (1975). The notation [105, 7, 7] indicates that measurements were made on 105 spores in seven samples in seven collections. The following abbreviations are used: L for lamellae, l for lamellulae, avl for average length, avw for average width, Q for quotient of length and width and avQ for average quotient. The abbreviation *L.* is used for '*Lepiota*' and *La.* for '*Leucoagaricus*'. The modern descriptions are based on North American collections, though the European material which has been used as comparison, is listed for completeness.

Taxonomic descriptions

1. *Lepiota roseolivida* Murrill

Figures 1-2

Lepiota roseolivida Murrill, Mycologia 4: 234. 1912.

Lepiota marriagei D.A. Reid, Nova Hedwigia 11, Suppl.: 20. 1966 (Fung. rar. ic. Col. 1);

Leucoagaricus marriagei (D.A. Reid) Bon, Doc. mycol. 6 (24): 44. 1976.

Leucoagaricus marriagei var. *ammovirescens* Bon, Doc. mycol. 22 (88): 31. 1993.

Description of type collection (W.A. Murrill 1138 (NY)) (Fig. 1)

Murrill (1912): "Pileus convex to expanded, thin, umbonate, gregarious, 2.5-4 cm. broad; surface dry, minutely and densely fibrillose-scaly, rose-lilac, livid in the center, becoming slightly darker on drying; lamellae white, unchanging, free, crowded, narrow; spores ellipsoid smooth, hyaline, 8-9 x 4-5 μ ; stipe slender, tapering upward, subglabrous, white or pallid, changing to lilac on drying, hollow, 7-10 cm. long, 2-5 mm. thick; annulus superior, movable, ample, membranous, lilac-tinted, becoming lilac on drying."

Type study

Basidiospores [20,1,1] in side view 7.1-9.6 x 3.9-4.9 μ m, on average 8.0 x 4.5 μ m, Q = 1.6-2.0, av Q = 1.77, oblong, many asymmetrical and amygdaliform, in frontal view oblong, thick-walled, colourless, dextrinoid, congophilous and metachromatic in Cresyl Blue. **Basidia** 19-23 x 7-8 μ m, 4-spored. Lamella edge sterile; **cheilocystidia** 25-48 x 7-12 μ m, narrowly utriform, narrowly clavate, narrowly ellipsoid-fusiform, to cylindrical with narrow pedicel, colourless, slightly thick-walled. **Pleurocystidia** absent. **Pileus covering** a cutis made up of repent hyphae, with terminal elements 60-190 x 8-12 μ m, tapering towards apex; up to three to five elements in a row with intracellular brownish pigment; pileus covering exuding greenish pigment in 10 % ammonia. **Clamp connections** absent.

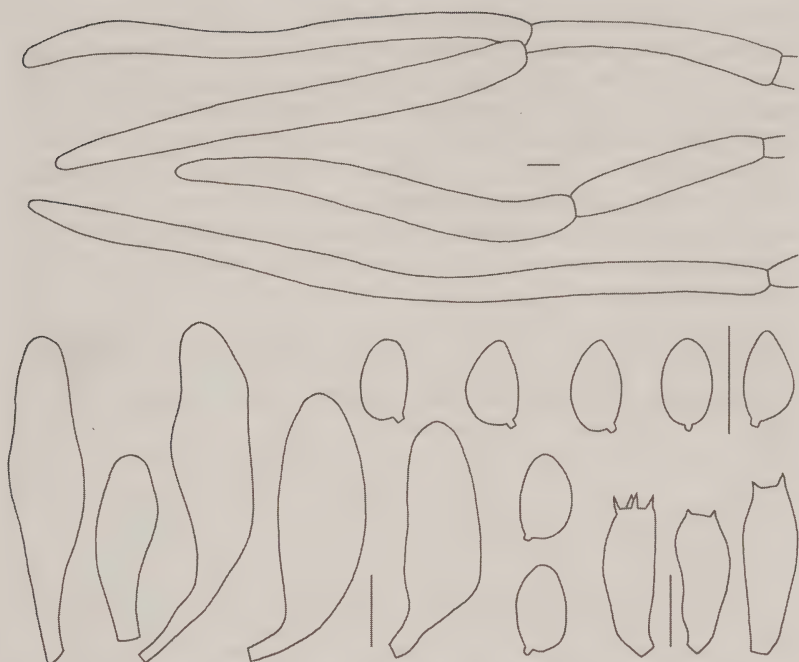


Fig. 1: *Lepiota roseolivida* – Spores, basidia, cheilocystidia and elements of pileus covering (all from holotype). Scale bar 10 μ m.

Description of modern material (Fig. 2)

Pileus 5-30 mm, widely conical, convex to plano-convex or wavy plano-convex with rounded to inconspicuous and low umbo, with age plano-concave to concave without umbo, when young with margin exceeding and overhanging lamellae, but with age equal, at centre (umbo) velvety-tomentose to slightly tufted-tomentose and around centre with radially arranged appressed short fibrils in narrow to cobwebby squamules, not or hardly showing underlying context, at margin often in v-shaped patches on white background, at centre beautiful lilac-purple (10E4), dark violet-pink (12DE5), pink-lilac (11-12CDE4) or dark purple (a bit more purple than 10R5/4), and often paler around centre (e.g. 10D4, 10D5), but sometimes dark violet (10DE5/4), with age with yellowish tinges from context. **Lamellae**, L = 40-45, l = 0-3, moderately to rather crowded, free, often distinctly so and up to 2 mm from stipe, ventricose or slightly ventricose, up to 3 mm wide, pale cream to distinctly cream or yellowish tinged especially so in older specimens, sometimes with pinkish tinges, with white cystidioid edge. **Stipe** 18-90 x 0.75-4 mm, sometimes bulbous, in most cases becoming wider downwards, up to 8 mm at base, often slightly compressed

in lower half, white in upper half, yellowish in lower half and in basal part with hints of lilac and purple, smooth, or slightly cystidiose above annulus, and sometimes slightly fibrillose in lower part, hollow. **Annulus** in general quite flimsy and not persistent, consisting of a small white cuff, irregularly ragged at lower edge, and a small flaring white part, with rim of pink-purple material as on pileus, in half of the collections completely coloured on the outside, lilac like pileus, and white on the inside. **Context** white, thin and dull in pileus, white to whitish and shiny in stipe. **Smell** very weak and indistinct, fungoid, or sweet and like rubber (as *Lepiota cristata* (Bolton : Fr.) P. Kumm.). **Taste** not recorded. **Spore print** white.

Basidiospores [105, 7, 7] in side-view 6.7-9.8 x 3.8-5.7 μm , on average 7.4-8.3 x 4.2-4.9 μm , Q = 1.4-2.3, average Q = 1.55-1.95, oblong to subcylindrical, many amygdaliform often with distinct though small apical papilla, in frontal

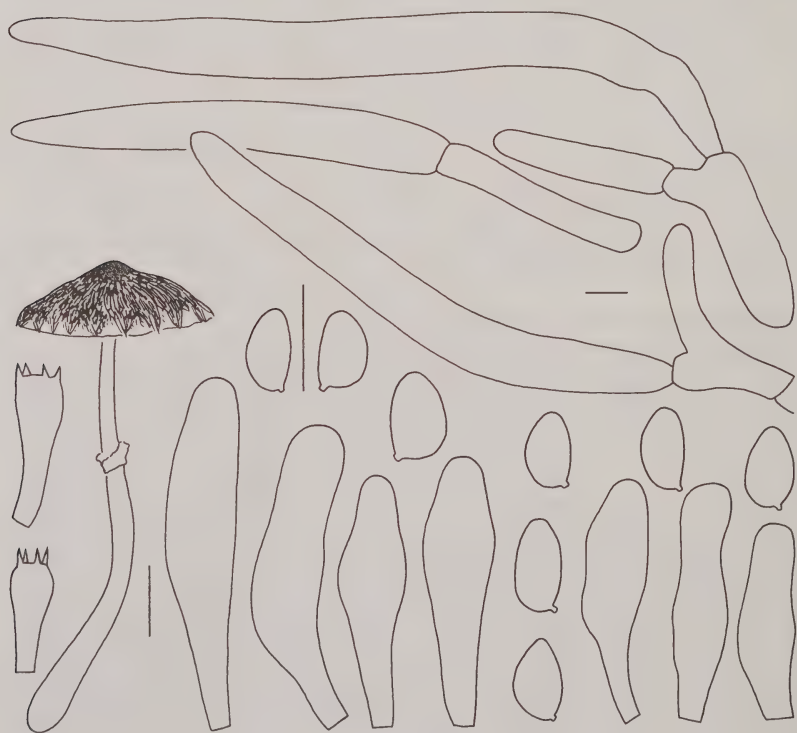


Fig. 2: *Lepiota roseolivida* – basidiocarp (ecv2586), spores (left three from ecv 2990; ecv3075), basidia (ecv3075), cheilocystidia (left four from ecv2990; ecv3075), elements of pileus covering (ecv3075). Scale bar 10 μm .

view oblong, with or without apical small papilla, thick-walled, colourless, dextrinoid, congophilous, and metachromatic in Cresyl blue. **Basidia** 15-26 x 6-9 μm , 4-spored, rarely 2-spored. Lamella edge sterile; **cheilocystidia** 21-62 x 5.5-13 μm , variable in shape, from narrowly utriform to wavy cylindrical or narrowly clavate, slightly thick-walled, colourless. **Pleurocystidia** absent. **Pileus** covering a loose cutis made up of repent hyphae, with terminal elements 60-190 x 8-12 μm , cylindrical or tapering towards apex; pigment intracellular and pinkish-lilac, more brown in older and dried material; cells further away from the apices with encrusting brownish pigments. **Stipe** covering a cutis of narrow, 2-3 μm wide hyphae with pale coloured walls; occasional hyphae with pigmented walls; below annulus with scattered hyphae as in pileus covering. **Clamp connections** absent.

Habitat and distribution – Solitary or in small groups, terrestrial and saprotrophic, in various forests, e.g. redwood forests and Monterey cypress groves, but also along a path in a more ruderal setting, widespread, and not uncommon, end of October-beginning of January.

COLLECTIONS EXAMINED – U.S.A., WASHINGTON, King Co., SEATTLE, SEWARD PARK, S.A. Trudell 95-293-01 (herb. Trudell) (Genbank nrITS EF121815); CALIFORNIA, Humboldt Co., PATRICK'S POINT STATE PARK, NEAR MUSSEL ROCK, 23.X.2003, E.C. Vellinga 3075; Mendocino Co., JACKSON STATE DEMONSTRATION FOREST, 'MUSHROOM CORNER', 22.XI.2003, D.E. Desjardin (coll. E.C. Vellinga 3129); 0.5 MILE SOUTH OF JUNCTION OF HIGHWAYS 1 AND 128, 17.XI.2006, E.C. Vellinga 3493; Marin Co., MUIR WOODS, 22.XI.1911, W.A. Murrill 1138 (Holotype, NY); POINT REYES, ALONG LIMANTOUR ROAD, 4.XI.2005, E.C. Vellinga 3348; POINT REYES, BAYVIEW TRAIL, 22.XI.2006, D. DeShazer 531; MOUNT TAMALPAIS, BOLINAS-FAIRFAX ROAD, 15.XI.2005, E.C. Vellinga 3368; Contra Costa Co., TILDEN REGIONAL PARK, ALONG UPPER PACKRAT TRAIL ABOVE JEWEL LAKE, 13.XI.1999, E.C. Vellinga 2378; *ibidem*, 4.XI.2000, E.C. Vellinga 2486 (Genbank nrLSU AY176395); *ibidem*, 23.XI.2001, E.C. Vellinga 2738; San Mateo Co., SAN FRANCISCO WATERSHED, 8.XII.2000, E.C. Vellinga 2586; *ibidem*, 7.I.2003, E.C. Vellinga 2990 (Genbank nrITS EF121816); *ibidem*, 5.XII.2003, E.C. Vellinga 3141; SAN MATEO CO. MEMORIAL PARK, ALONG POMPONIO TRAIL, northeast facing slope, 31.X. 2000, E.C. Vellinga 2475 (Genbank nrITS AY176394).

THE NETHERLANDS, prov. Noord-Holland, HEILOO, HEILOOËRBOSCH, 2.X.1996, F.A. v.d. Bergh (L); prov. Limburg, ELSLOO-GEULLE, BUNDERBOS, 9.IX.1996, E.C. Vellinga 2005 (L) (Genbank nrITS AF482866).

All collections in UC unless otherwise stated.

Comments – *Lepiota roseolivida* is a slender, elegant, fragile and unusually and subtly coloured little mushroom, which cannot be confused with any other species. Basidiocarp sizes vary, and basidiocarps with 5 mm wide mature pilei have been found in some habitats. The observations on the type collection are in agreement with those by Smith (1966).

Leucoagaricus marriagei is considered a synonym here. The macroscopic and microscopic characters of the two species are virtually identical, though

Reid (1966) described the spores as rather narrow (3.2-4 μm wide), which is not confirmed by measurements on Dutch material identified as *La. marriagei* (Vellinga 2001), where the spores were found to be 4.0-5.0 μm wide; Migliozi & Perrone (1991) described Italian collections with 3.7-4.1 μm wide spores.

European literature shows that there is some confusion about the differences between *La. marriagei* and *La. ionidicolor* Bellù & Lanzoni (e.g. Bon 1976), *La. tener* (P.D. Orton) Bon and *L. brunneocingulatus* (P.D. Orton) Bon. *Leucoagaricus ionidicolor* has more greyish bluish lilac tinges, is more robust with a relatively wider pileus, and the pileus covering consists of erect long tapering elements. *Leucoagaricus tener* is a brown fragile species, copiously provided with clear golden droplets when fresh, and *La. brunneocingulatus* is also brown-capped, lacking such drops.

Sequences of the nrITS (Vellinga 2004b and new sequences) show up to nine base differences among the three American collections sampled (Genbank accession numbers are provided with the collection data), and the sequence of the one sampled European collection falls within this variation. The four collections studied form a monophyletic group. All collections exhibit the same positive reaction in ammonia, but shape of spores and cheilocystidia shows some variation (Fig. 2).

Lepiota roseolivida has a weak reaction in ammonia; the pileus covering cells for instance exude a brownish pigment when placed in ammonia. The recognition of a separate variety, based on this character, seems superfluous, hence the placement of *La. marriagei* var. *ammovirescens* (Bon 1993) in the synonymy of *L. roseolivida*.

Lepiota roseolivida is known from western North America and Europe. It has not yet been recorded from other parts of North America, though its occurrence there is expected. It has been found regularly in coastal forests in the western parts of the U.S.A., but due to its small size, and the fact that it grows in small groups or solitarily, it can easily be overlooked. It is rare in Europe, but reported there occasionally (e.g. Henrici 2001 (United Kingdom), Migliozi & Perrone 1991 (Italy)).

2. *Lepiota decorata* Zeller

Figures 3-5

Lepiota pulcherrima Zeller, Mycologia 14: 186. 1922, non *Lepiota pulcherrima* P.W. Graff, 1914; *Lepiota decorata* Zeller, Mycologia 21: 103. 1929.

Leucoagaricus idae-fragum Guinb., Boisselet & G. Dupuy, Bull. trimest. Soc. mycol. Fr. 114 (3): 14. 1998.

Description of type collection (J.W. Severy & S.M. Zeller 2123 (NY)) (Fig. 3)

Zeller (1922): "Pileus 6-12 cm. broad, subhemispheric at first, then convex to quite plane, moderately fleshy, young buttons quite solid, acajon-red to Vandyke red at the center, venetian or alizarine-pink on the margin, often fading to a silvery livid-pink in age; cuticle on margins of older specimens split; surface appearing velvety because of the innate-pubescent towards the center, nearly glabrous or silky on the margin or squamulose when closely covered by another

pileus, becoming slightly appressed-scaly in age due to growth. Margin sterile. Flesh white, rather thin except disk. Gills free, white, close, broad, rounded behind, edges even. Stem 5-10 cm. long, 8-12 mm. thick, equal or tapering upward, slightly bulbous, peronate by a thin membrane colored like this pileus about one half to two thirds of the way up to the rather large, flaring, rather fleshy persistent annulus, white within, white to pinkish above the annulus. Spores smooth, white, oblong, $3-4.5 \times 5-8 \mu$, usually uniguttulate. Pleasant flavor. Odor mildly farinescens.”

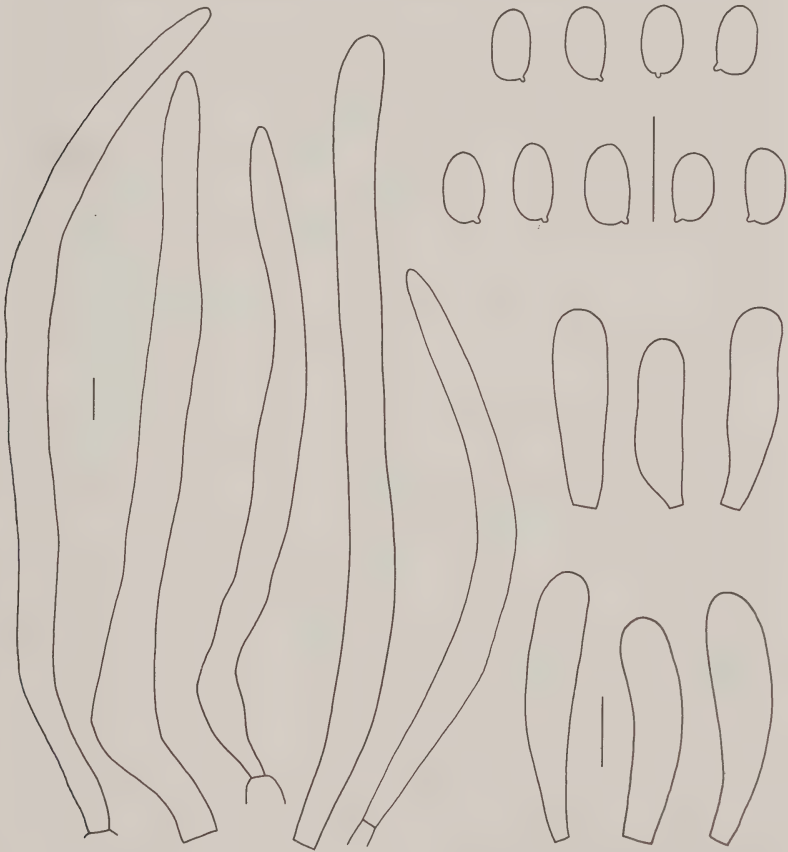


Fig. 3: *Lepiota decorata* – spores, basidia, cheilocystidia, elements of pileus covering (all from holotype). Scale bar 10 μ m.

Type study

Basidiospores [21,1,1] in side view $5.9-7.8 \times 3.6-4.4 \mu$ m, on average $6.6 \times 4.0 \mu$ m, $Q = 1.45-1.9$ average $Q = 1.66$, ellipsoid to oblong, with rounded apex, rarely amygdaliform, with central guttule, thick-walled and without germ

pore, congophilous, dextrinoid and metachromatic in Cresyl blue. **Basidia** 4-spored, difficult to revive. Lamella edge sterile; **cheilocystidia** 20-38 x 5.5-8.5 μm , narrowly clavate, cylindrical, thin-walled, colourless. **Pleurocystidia** not observed. **Pileus covering** made up of upright elements 100-240 x 7-13 μm , tapering towards apex, often widest above base, with brownish intracellular pigment, exuding pigment in ammonia. **Clamp connections** absent.

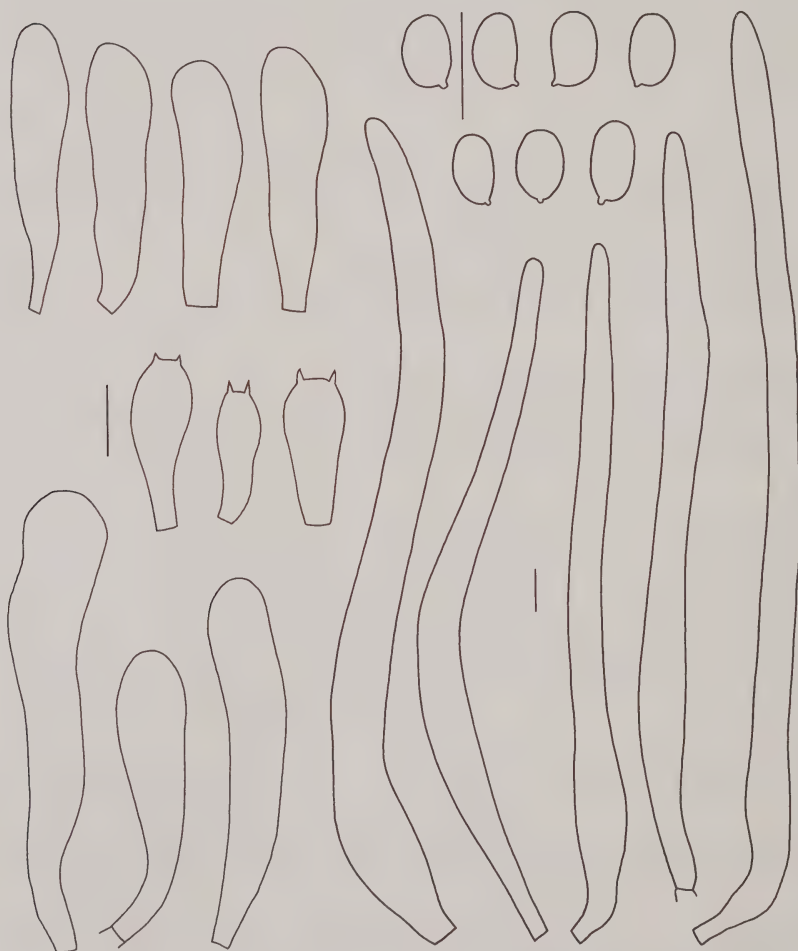


Fig. 4: *Lepiota decorata* – spores (ecv2810), basidia (ecv2810), cheilocystidia (upper ones from ecv2810; lower three from ecv3453), elements of pileus covering (left two from ecv2810; right from scale bar from ecv3190). Scale bar 10 μm .

Description of modern material (figs. 4-5)

Pileus 38-80 mm, campanulate with umbo, hemispherical-convex with inflexed margin when young, to wavy plano-convex with low umbo with age, beautiful rose-vinaceous purple, pink purplish, or pink-purple, darkest at centre, and slightly paler at margin (at centre 10D5, 10E5, around centre 10A3, 11C6-11C5, or in the range of 12AB3-4), velvety-tomentose at centre and closed, around centre in some places breaking open into small fibrillose adnate tufts on whitish background, or velvety to fine squamulose in outer part of pileus, in one specimen slightly radially fibrillose near margin; margin exceeding lamellae, entire or slightly fringed with age, white at first, brownish with age and pressure. **Lamellae**, $L = 90-100$, $l = 0-3$, crowded, free, but not remote from stipe, slightly or not ventricose, up to 7 mm wide, white to pale cream with white, irregularly eroded cystidioid edge. **Stipe** 75-90 x 7-11 mm, cylindrical, but in some specimens gradually widening towards base, at utmost base up to 14 mm wide, at apex white to whitish, when young only with some pink tinges at base, but with age below annulus with pinkish sheen or with a wash of lilac-rose (11A3-2), strongest near base, caused by long coloured adnate fibrils, and pubescent (lens!) in basal part, hollow, protruding into pileus; with copious white mycelium or mycelial mat at base. **Annulus** easily torn apart, consisting of an ascending or descending pale pink cuff with an up to 4 mm wide flaring part, with pink underside, concolorous with pileus or slightly paler, and dark pink rim, and white to pale pink inner upperside. **Context** relatively thick in pileus (c. 5 mm thick), white and dull, white to creamy shiny in stipe, not discolouring when cut. **Smell** astringent lepiotoid, strong and fungoid or indistinct. **Taste** and **spore print** colour not recorded.

Basidiospores [55,4,4] in side view $5.4-7.6 \times 3.2-4.9 \mu\text{m}$, $av_l \times av_w = 5.8-6.8 \times 3.7-4.0 \mu\text{m}$, $Q = 1.37-1.88$, $avQ = 1.47-1.71$, ellipsoid to oblong, with abaxial side in most spores straight, in most spores with rounded apex, rarely slightly amygdaliform, in frontal view ellipsoid-oblong, with one guttule, thick-walled, without a germ pore, dextrinoid, congophilous, and metachromatic in Cresyl blue. **Basidia** $18-36 \times 6.5-8.5 \mu\text{m}$, 4-spored, rarely 2-spored. Lamella edge sterile; **cheilocystidia** $23-65 \times 7-13 \mu\text{m}$, narrowly clavate, cylindrical, slightly utriform, colourless. **Pleurocystidia** absent. **Pileus covering** in young specimens more or less a cutis with long tapering terminal elements; these terminal elements more erect and giving a trichodermal aspect to covering in mature specimens; terminal elements $120-250 \times 9-18 \mu\text{m}$, cylindrical or slightly widened above base, with rounded apex, with pinkish or brownish intracellular pigment, and incrusting pigment in lower hyphae. **Stipe covering** of lower part of stipe a tomentum of narrow, $2-3 \mu\text{m}$ wide, interwoven hyphae with yellow refracting walls. **Clamp connections** absent.



Fig. 5: *Lepiota decorata* – basidiocarp (ecv3453; colour version available at <http://plantbio.berkeley.edu/~bruns/people/ev.html>). Photo by John Lennie.

Habitat and distribution – Solitary or in small groups, terrestrial in forests, ranging from old-growth forest with *Pseudotsuga menziesii*, a mixed *Acer macrophylla*, *Thuja plicata*, *Alnus rubra* wood to a *Eucalyptus* plantation with grassy undergrowth, rare, known from a handful of places in Oregon (Portland, Corvallis) and California (Contra Costa Co.); Sundberg (1967) and Burlingham (1945) mentioned three other coastal Californian localities, all with *Cupressus macrocarpa*; fruiting relatively late in the mushroom season; the type collection was made on November 1, but modern collections are all from the end of December; the species fruits into January at the Californian site.

COLLECTIONS EXAMINED – U.S.A., OREGON, Benton Co., CORVALLIS, 1 Nov. 1920, J.W. Severy & S.M. Zeller 2123 (NY); Multnomah Co., PORTLAND, 6720 NW SKYLINE BLVD, L.L. Norvell 2051224 (Pacific Northwest Mycology Service Herbarium); CALIFORNIA, Contra Costa Co., TILDEN REGIONAL PARK, E.C. Vellinga 2810 (GenBank nrITS AY243645); *ibidem*, 25 Dec. 2003, E.C. Vellinga 3190; *ibidem*, 24 Dec. 2005, E.C. Vellinga 3453 (all in UC).

Comments – This is one of the most beautiful fungi in California, easily recognized by its size and deep pink overall colours. Its colours change quickly after collecting, and the specimens exhibit a more pink colour in the field than after transport.

It fruits consistently late in the season, and has been found in Oregon and in California at the same time of the year. It is rare, and only encountered in a couple of localities.

Leucoagaricus idae-fragum has been described from several localities on the Atlantic coast of France (Guinberteau et al. 1998). The only difference with *L. decorata* is the often, but not always, persistent white velum on the pileus, and the slightly bigger spores, but all other characters are in concordance with *L. decorata* as described here. *Leucoagaricus idae-fragum* is considered a synonym of *L. decorata*. A very detailed description of *La. idae-fragum* was given by Guinberteau et al. (1998).

Lepiota decorata is a sister species to *Leucoagaricus ionidicolor* in the phylogenetic analyses of the nrITS sequences (Vellinga 2004b). *Leucoagaricus ionidicolor* shares the same type of pileus covering structure with *L. decorata*, but is a smaller, violaceous coloured species, occurring in Europe. *Leucocoprinus caeruleoviolaceus* D.A. Reid is a synonym of *La. ionidicolor*. It is a rare species, fruiting under relatively dry circumstances throughout Europe (e.g. Antonín & Vágner 1997, Vasas 2000, Vellinga 2001, Vila et al. 1997).

Lepiota decorata exhibits a disjunct distribution; it is so far known from the western parts of North America, and the western parts of France. Records of this species from other parts of North America could be expected.

Acknowledgements

The care of the curator of fungi in the New York Botanical Garden is appreciated. Steven Trudell and Lorelei Norvell sent me their specimens on loan. John Lennie suggested valuable linguistic improvements of the text. P. Brandon Matheny and Ana Esperanza Franco Molano gave me valuable feedback on an earlier version. Partial funding by NSF grant DEB 0618293 is gratefully acknowledged.

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Lepiotaceous fungi in California, U.S.A. – 4. Type studies of *Lepiota fumosifolia* and *L. petasiformis*

ELSE C. VELLINGA

vellinga@nature.berkeley.edu or *ecvellinga@comcast.net*

Department of Plant and Microbial Biology, University of California at Berkeley,
Berkeley, CA 94720-3102, U.S.A.

Abstract – The type collections of *Lepiota fumosifolia* and *L. petasiformis* were studied. *Lepiota fumosifolia* has cheilocystidia and abundant pleurocystidia with yellow contents and exudates; spores are smooth, clamp connections present and velar cells globose. This is an older name for *Cystolepiota cystidiosa*, *C. luteicystidiata* and *L. lycoperdoides*. *Lepiota petasiformis* is characterized by rough spores, absence of cystidia and clamp connections, and elongate velar cells. *Cystolepiota pulverulenta* is morphologically identical, and synonymized with it. Three new combinations are made in the genus *Cystolepiota*, viz. *C. fumosifolia*, *C. oregonensis*, and *C. petasiformis*. A key is provided for all *Cystolepiota* species recorded from western North America.

Key words – Agaricaceae, biodiversity

Introduction

In an ongoing effort to inventory, describe and catalogue the lepiotaceous fungi (white spored agaricoid members of the family Agaricaceae) in California, the type collections of *Lepiota fumosifolia* and *L. petasiformis*, two species with a granular-mealy pileus covering, described from Washington by Murrill (1912), were studied. Both species turn out to belong to *Cystolepiota*, new combinations are made, and their position is discussed. The occurrence of these species in California is confirmed. To facilitate their recognition, a key is provided for the identification of *Cystolepiota* species in western North America.

Methods

Standard methods for microscopic observations were used; material was revived in Congo red in ammonia; Melzer's reagent and Cresyl blue were used to study reactions of the spore walls. Terminology follows Vellinga (2001). The following notations and abbreviations are used: [15,1,1] indicates that measurements were made on 15 spores in one sample from one collection; avl stands for average length, avw for average width, Q for quotient of length and width and avQ for average quotient.

Taxonomic descriptions

Cystolepiota fumosifolia (Murrill) Vellinga, comb. nov.

Figures 1-2

MYCOBANK MB 510370

Basionym: *Lepiota fumosifolia* Murrill, Mycologia 4: 233. 1912.*Lepiota cystidiosa* A.H. Sm., Papers Mich. Acad. Sci., Arts Letters 27: 58. ('1941')1942;*Cystolepiota cystidiosa* (A.H. Sm.) Bon, Doc. mycol. 11 (43): 26. 1981.*Lepiota luteicystidiata* D.A. Reid, Nova Hedwigia 13, Suppl. (Fung. rar. Ic. col. 2): 9.1967; *Cystolepiota luteicystidiata* (D.A. Reid) Bon, Doc. mycol. 6 (24): 43. 1976.*Lepiota lycoperdoides* Kreisel, Wiss. Z. Ernst Moritz Arndt-Univ. Greifswald 16: 238.1967; *Cystolepiota luteicystidiata* var. *lycoperdoides* (Kreisel) Bon, Doc. mycol. 11 (43): 26. 1981.

Murrill (1912): "Pileus convex, not umbonate, gregarious, 3 cm. broad; surface dry, white with isabelline, granular scales, the center isabelline; lamellae free, broad, rather crowded, white, becoming fumous on drying; spores oblong-fusiform, smooth, hyaline, $12 \times 7 \mu$; stipe equal or tapering upward, cylindric, smooth, white, furfuraceous, pale-avellaneous below, 6 cm. long, 6 mm. thick; veil soon breaking into fragments which cling to the margin and stipe.

"Type collected on the ground in woods near Seattle, Washington, October 20-November 1, 1911, W.A. Murrill 229."

Type study

Basidiospores [20,1,1] in side view $4.9\text{--}5.7 \times 2.6\text{--}3.1 \mu\text{m}$, $\text{avl} \times \text{avw} = 5.2 \times 2.9 \mu\text{m}$, $Q = 1.6\text{--}2.0$, $\text{av}Q = 1.8$, oblong with flattened adaxial side, in frontal view oblong or obovoid, often in tetrads, non-dextrinoid, non-amyloid, metachromatic in Cresyl blue, smooth. **Basidia** 4-spored. **Lamella edge** sterile, set with cheilocystidia. Individual cheilocystidia hard to recover; cheilocystidia narrowly clavate with separate capitulum, with yellow contents and yellow exudates. **Pleurocystidia** numerous, about $25 \mu\text{m}$ apart from each other, easily recognizable because of the yellow exudate which turns red in Congo red, most numerous close to lamella edge, similar in shape to cheilocystidia, but individual cystidia not recovered. **Pileus covering** made up of loosely arranged globose and ellipsoid cells, $25\text{--}60 \times 25\text{--}40 \mu\text{m}$, with brown walls. **Clamp connections** present.

COLLECTIONS EXAMINED (the above description is based on the type only) –U.S.A., WASHINGTON, NEAR SEATTLE, X.20-XI.1, 1911, W.A. Murrill 229 (holotype, NY).

CALIFORNIA, Humboldt Co., HUMBOLDT REDWOODS STATE PARK, SOUTH OF WEOTT, 12.XI.2004, E.C. Vellinga 3278 (UC; Genbank nrITS EF121817).

Comments – *Lepiota fumosifolia* is transferred to the genus *Cystolepiota* on account of its pileus covering made up of loosely arranged globose cells, and the small, non-dextrinoid spores.

Most striking in this species is the abundance of cystidia, on the edge and the sides of the lamellae. The pleurocystidia stand out as dark red dots in Congo red. The yellow exudate and contents are visible when viewed in ammonia. As

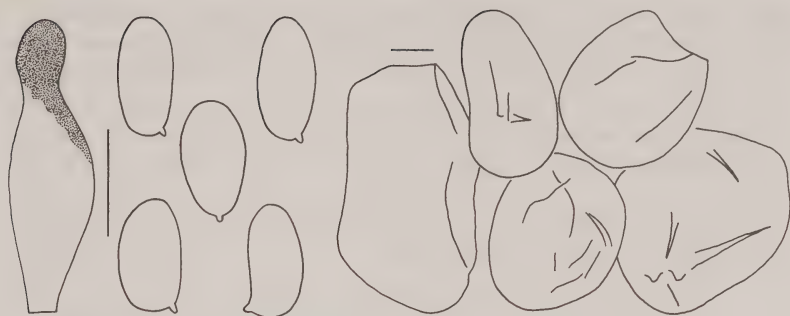


Fig. 1: *Cystolepiota fumosifolia* – spores, cheilocystidium, pileus covering elements. Scale bar is 5 μm (spores) or 10 μm (cystidium, pileus covering elements). All from holotype.

Smith (1966) also pointed out, the spores are not $12 \times 7 \mu\text{m}$ and fusoid, as stated by Murrill (1912), but much smaller and oblong.

Cystolepiota cystidiosa, described from Michigan (Smith 1942) is identical, in macroscopical and microscopical characters and is placed in the synonymy of *L. fumosifolia*.

A discussion and comparison of the type collections of *C. cystidiosa*, *L. lycoperdoides* and *C. luteicystidiata* was given by Vellinga & Huijser (1998).

Murrill (1912) indicated the macroscopical differences between *C. fumosifolia* and *C. petasiformis*. The pileus of *C. fumosifolia* is convex, whereas in *C. petasiformis* it is often conical because of the copious velum cells. The lamellae of *C. fumosifolia* turn a smoky colour on drying, a feature also described by Vellinga & Huijser (1998) for European material of this species (as *C. cystidiosa*), whereas the lamellae of dried specimens of *C. petasiformis* are cream coloured.

Microscopically, the differences are more conspicuous: abundant cheilocystidia and pleurocystidia in *C. fumosifolia*, none in *C. petasiformis*; globose velar cells on the pileus in *C. fumosifolia*, and elongate, irregularly-shaped cells in *C. petasiformis*; and smooth spores in *C. fumosifolia*, versus rough, finely warted spores in *C. petasiformis*.

Cystolepiota fumosifolia appears to be rare in the Pacific states of North America. The present author has seen the species once, in the redwood forests of northern California (see collections examined).

Lepiota oregonensis can be confused with *C. fumosifolia*. It is a smaller species, with rusty-brown discoloration, without pleurocystidia. The cheilocystidia and spores are of the same size and shape as those in *C. fumosifolia*. *Lepiota oregonensis* comes very close to the European species *C. hetieri* (Boud.) Singer, the only difference being the presence of pleurocystidia (at least close to the

lamella edge) in *C. hetieri*, and the absence of pleurocystidia in *L. oregonensis*. Smith (in Smith & Sundberg 1979) noted that clamp connections are also absent; however, study of the type specimen revealed that they are present, as in all *Cystolepiota* species with globose velar cells (pers. obs.). The new combination *Cystolepiota oregonensis* (H.V. Sm.) Vellinga (MYCOBANK MB 510371; basionym *Lepiota oregonensis* H.V. Sm. in Mycotaxon 8: 449. 1979) is here proposed.

This species has not been found in California yet, but is known from several places in western Oregon and Washington.

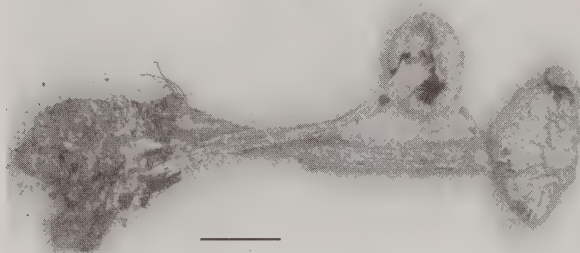


Fig. 2: *Cystolepiota fumosifolia* – dried specimens of collection ecv3278. Compare with the scan of the type collection conserved at NY, at the web site <http://207.156.243.8/emuwebnybg/pages/common/imagedisplay.php?irn=103199> (accessed on 13 November 2006).

Cystolepiota petasiformis (Murrill) Vellinga, comb.nov.

MYCOBANK MB 510372

Basionym: *Lepiota petasiformis* Murrill, Mycologia 4: 232. 1912.

Lepiota pulverulenta Huijsman, Persoonia 1: 328. 1960; *Leucoagaricus pulverulentus* (Huijsman) Bon, Doc. mycol. 8 (30-31): 70. 1978; *Leucoagaricus pulverulentus* (Huijsman) M.M. Moser, Röhrlinge-Blätterpilze, 4. Aufl.: 246. 1978; *Cystolepiota pulverulenta* (Huijsman) Vellinga, Persoonia 14: 407. 1992; *Pulverolepiota pulverulenta* (Huijsman) Bon, Doc. mycol. 22 (88): 30. 1993.

Leucoagaricus pulverulentus f. *minimus* Bon, Migl. & Brunori, Doc. mycol. 19 (75): 54. 1989; *Pulverolepiota pulverulenta* f. *minima* (Bon, Migl. & Brunori) Bon, Doc. mycol. 22 (88): 30. 1993; *Cystolepiota pulverulenta* f. *minima* (Bon, Migl. & Brunori) La Chiua, Riv. Micol. 41: 152. 1998.

Murrill (1912): "Pileus thin, hat-shaped, with prominent conic umbo, scattered or gregarious, 1.5-2.5 cm. broad; surface dry, rosy-isabelline, or about the color of the back of the hand, covered with an abundance of fine powder; lamellae free, subdistant, rather broad, white; spores ellipsoid, smooth, hyaline, minute, $3.5 \times 2 \mu$; stipe slender, tapering upward, clothed with powder like the pileus, reaching 5 cm. long and 2-3 mm. thick; veil fugacious, not forming an annulus.

Figure 3

"Type collected in humus in woods near Seattle, Washington, October 20-November 1, 1911, W.A. Murrill 629. Also collected in the same region, Zeller 119. It suggests some forms of *L. cretacea*."

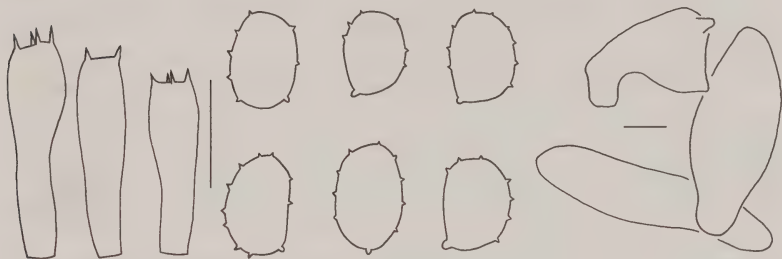


Fig. 3: *Cystolepiota petasiformis* – spores, basidium, pileus covering elements. Scale bar is 5 μm (spores) or 10 μm (basidia, pileus covering elements). All from holotype.

Type study

Basidiospores [20,1,1] in side view 3.9-5.4 x 2.6-3.2 μm , $\text{avl} \times \text{avw} = 4.7 \times 2.8 \mu\text{m}$, $Q = 1.6\text{--}1.85$, $\text{av}Q = 1.66$, oblong with flattened adaxial side, in frontal view oblong, congophilous, not dextrinoid, and metachromatic in Cresyl Blue, with small warts or spines. **Basidia** 14-21 x 5-6 μm , 4-spored, without clamp connection at base. **Lamella edge fertile**; **cheilocystidia** absent. **Pleurocystidia** absent. **Pileus covering** made up of loosely arranged irregular, oblong and some subglobose cells, around 22-70 x 8-22 μm , with pale brown walls, hard to recover. **Clamp connections** absent.

COLLECTIONS EXAMINED (the above description is based on the type only) – U.S.A., WASHINGTON, NEAR SEATTLE, X.20-XI.1, 1911, W.A. Murrill 629 (holotype, NY); Clallam Co., JOYCE, 11.X.1935, A.H. Smith 3104 (MICH); OLYMPIC NATIONAL PARK, WALL CREEK, 29.IX.1941, D.E. Stuntz (coll. A.H. Smith 17388) (MICH).

OREGON, MT. HOOD, 24.IX.1922, C.H. Kauffman (MICH).

CALIFORNIA, San Mateo Co., SAN FRANCISCO WATERSHED, 8.XII.2000, E.C. Vellinga 2572 (UC; genbank nrITS AF391035); *ibidem*, 23.XII.2002, E.C. Vellinga 2968 (UC); *ibidem*, 28.I.2003, E.C. Vellinga 3017 (UC); *ibidem*, 25.II.2003, E.C. Vellinga 3048 (UC); Humboldt Co., HUMBOLDT REDWOODS STATE PARK, SOUTH OF WEOTT, 8.XI.2004 (UC); Marin Co., POINT REYES, BEAR VALLEY TRAIL, 26.XI.2004, E.C. Vellinga 3322 (UC); MT TAMALPAIS, BOLINAS-FAIRFAX ROAD, 15.XI.2005, E.C. Vellinga 3373 (UC).

Comments – *Cystolepiota petasiformis* is easily recognized because of the copious velum on the basidiocarps often forming a conical top on the pileus, the slightly rough spores, and the absence of cystidia and clamp connections. The roughness of the spores in this species has not been noted before, though with a good 100x objective it is easily discernible.

Spores from the Kauffman collection from Mt Hood in Oregon, are a bit longer than those of the type: [11,1,1] 5.1-6.0 x 2.7-3.1 μm , $\text{avl} \times \text{avw} = 5.5 \times 3.0$ μm , $Q = 1.7\text{-}2.0$, $\text{av}Q = 1.87$, but other characters are in agreement with those for *C. petasiformis*.

Lepiota petasiformis is transferred to *Cystolepiota* here. Singer (1975, 1986) listed *L. petasiformis* (as *L. petasitiformis*) as "obviously" belonging to *Cystolepiota*, but he did not propose a new name for them, neither did he cite the basionym. Though there are some morphological differences (e.g. *Cystolepiota* species have clamp connections and smooth spores), in other respects it fits well into the genus. In analyses based on molecular characters (Vellinga 2003, 2004) monophyly of *Cystolepiota* including *C. petasiformis*, is acceptable, but further research on this group and its relationships with *Lepiota* sect. *Echinatae* and the genus *Melanophyllum* are needed.

Cystolepiota pulverulenta is tentatively placed in the synonymy of *C. petasiformis*, to which it is morphologically very similar. It should be noted that Huijsman (1960) did not notice the roughness of the spores of *L. pulverulenta*. The present author does not know how to distinguish the two morphologically, but the nrITS sequences of two collections, representative of the taxa in western North America and in Europe, contain eight differences. These collections are sister taxa forming a monophyletic group in the sample studied (Vellinga 2003). It is not known whether the type collection from Washington has the same nrITS sequence as the Californian collection.

Vellinga (1992, 2003) discussed the generic placement of this species or species complex. The species has been accommodated in *Lepiota* (Huijsman 1960), *Leucoagaricus* (Bon 1978), *Cystolepiota* (Vellinga 1992) and its own genus *Pulverolepiota* (Bon 1993).

Cystolepiota petasiformis is rare in California, but has been found scattered throughout the western part of the state, in Monterey cypress, and coastal Redwood forests (see under 'Collections examined'). Sieger (2003) included it in his key but noted that he has never seen the species in Washington.

Key to the *Cystolepiota* species in western North America

1. Stipe and pileus with lilac and violaceous tinges; smell strong, of coal gas (indole), like the smell of *Tricholoma sulphureum* (Bull. : Fr.) P. Kumm. and *T. inamoenum* (Fr. : Fr.) Gillet *C. bucknallii*¹
1. Stipe and pileus pinkish, white, or whitish and often discolouring with age, without lilac or violaceous tinges, and not smelling of coal gas, but of *Lepiota cristata* (Bolton : Fr.) P. Kumm.

¹ *Cystolepiota bucknallii* (Berk. & Broome) Singer & Cl  men  on is rare in the Pacific Northwest (Sieger 2003), and has not yet been found in California.

2. Pileus covering copious, made up of elongate inflated irregular cells; basidiospores rough; clamp connections absent *C. petasiformis*
2. Pileus covering made up of globose cells; basidiospores smooth; clamp connections present
3. Basidiocarps slender; pileus small (about 1 cm, rarely up to 2 cm) and white; stipe vinaceous, especially at base; cheilocystidia absent *C. seminuda*²
3. Basidiocarps slender to quite robust, with pink pileus, or starting out white and discolouring isabelline to rust-brown; cheilocystidia present
4. Pileus covered with small pink granulate warts, which do not change colour *C. moelleri*³
4. Pileus covered in white or whitish floccose granular velum, changing colour with age to isabelline or rusty brown
5. Basidiocarp with age with isabelline colours; pleurocystidia abundant over entire surface of lamellae; pleurocystidia and cheilocystidia with yellow contents and exudates *C. fumosifolia*
5. Basidiocarp with rusty brown colours with age; pleurocystidia absent; some yellow contents or exudates can be present in cheilocystidia . . *C. oregonensis*

Acknowledgements

Curators of the herbaria NY and MICH are acknowledged for the loan of type material and other collections. The Mycological Society of America's A.H. and H.V. Smith Award enabled me to visit the herbarium of the University of Michigan at Ann Arbor, and see the specimens in situ. The San Francisco Public Utilities Commission granted permission to inventory the cypress groves of the San Francisco watershed area (west of Crystal Spring Reservoir). Christian Lange and Ana Esperanza Franco Molano gave much appreciated comments on an earlier version. Partial funding by NSF grant DEB 0618293 is gratefully acknowledged.

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² *Cystolepiota seminuda* (Lasch) Bon is the most common *Cystolepiota* species in the area, and can be found in various forest types.

³ *Cystolepiota moelleri* Knudsen is known from the state of Washington (Birkebak, pers. comm.).

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A new species of *Phaeoramularia* on *Papaveraceae*FENG-YAN ZHAI¹ YING-LAN GUO² YU LI^{1*}¹fengyan780103@163.com ^{1*}yuli966@126.com

Jilin Agricultural University

Changchun 130118, China

²guoyl@sun.im.ac.cn

Institute of Microbiology, Chinese Academy of Science

Beijing 100080, China

Abstract—A new species, *Phaeoramularia papaveris* on *Papaver nudicaule* (*Papaveraceae*) is reported. It is described and compared with other similar hyphomycetes occurring on *Papaveraceae*: *Cercospora papaveris*, *C. papavericola*, *Passalora bocconiae*, and *Ramularia chelidonii*. The holotype and isotype specimens are deposited in HMAS and HMJAU.

Key words—imperfect fungi, taxonomy

Introduction

In our recent study, we found a leafspot fungus on *Papaver* from Inner Mongolia, China that distinctly differed from other similar leafspot fungi known to occur on *Papaveraceae*. We identified as a previously undescribed species of *Phaeoramularia*, a genus that previously has not been known to occur on *Papaveraceae*. The new species is described below.

Taxonomy

Phaeoramularia papaveris F.Y. Zhai, Y.L. Guo & Yu Li, sp. nov.

Fig. 1

MB510350

Maculae amphigenae, orbiculares vel ellipsoideae, 1.0–6.0 mm diam., aliquando confluentes, centro griseo-brunneae vel brunneae, margine atro-brunneae, extus flave halonatae. Caespituli amphigeni. Mycelium immersum. Stromata substomata, parva vel bene evoluta, subglobosa, pallide brunnea, 18.5–45.0 µm diam. Conidiophora emergena per stomata, laxe vel dense fasciculata, pallide olivacea, olivaceo-brunnea vel pallide brunnea ubi fascicula, laevia, non ramosa, erecta vel leviter curvata, 0–5-geniculata, ad apicem conico-truncata, 0–4-septata, 15.5–60.0×2.0–5.0 µm. Cicatrices conspicue incrassatae, 1.0 µm. latae. Conidia obclavato-cylindrica vel cylindrica, subhyalina vel pallide olivacea,

*Corresponding author

catenata, laevia, recta vel interdum leviter curvata, ad apicem conico-truncata ad basin obconico-truncata, 0–4-septata, 10.0–44.0×1.5–5.0 µm.

Leaf spots amphigenous, circular or elliptical, at the edge of the leaf semi-circular, 1.0–6.0 mm in diam., sometimes confluent, center grayish brown to brown, margin dark brown, sometimes with a yellow halo on the upper surface, paler on the lower surface. Fruiting amphigenous. Mycelium immersed. Stromata substomatal, small to well-developed, subglobose, pale brown, 18.5–45.0 µm in diam. Conidiophores emerging through stomata, loosely to densely fasciculate, pale olivaceous, olivaceous brown to pale brown when in cluster, paler and narrower towards the apex, smooth, not branched, straight to slightly curved, 0–5-geniculate, conically truncate at the apex, 0–4-septate, 15.5–60.0×2.0–5.0 µm. Conidial scars conspicuously thickened, 1.0 µm wide. Conidia obclavate-cylindrical to cylindrical, subhyaline to pale olivaceous, catenate and in branched chains, smooth, straight to slightly curved, conically truncate at the apex, obconically truncate at the base, 0–4-septate, occasionally constricted at septa, 10.0–44.0×1.5–5.0 µm.

On leaves of *Papaver nudicaule* L. (*Papaveraceae*), Arshan, Inner Mongolia, China, 9 VIII 1991, coll. Y. L. Guo, no. 1524 (HMAS 143915, holotype; HMJAU 30002, isotype).

Comments: Both *Cercospora papaveris* Nakata (Takimoto 1918) and *C. papavericola* Chupp (Chupp 1954), which also occur on *Papaver* species, differ from the newly described *Phaeoramularia papaveris* in having darker conidiophores (the former dark brown, the latter pale to medium olivaceous brown). Additionally, *C. papaveris* possesses wider (5.0–9.0 µm) conidiophores and longer and wider (50.0–115.0×5.0–9.0 µm) obclavate dark yellowish-brown conidia, while *C. papavericola* is distinguished by longer conidiophores (75.0–350.0 µm) and hyaline, acicular conidia.

Passalora bocconiae (Chupp) U. Braun & Crous (Braun et al. 2002; = *Cercospora bocconiae* Chupp) on *Bocconia frutescens* L. (*Papaveraceae*) is distinguished from our newly described *Phaeoramularia papaveris* in that *P. bocconiae* exhibits epiphyllous fruiting; slight stromata; fascicles that are densely compact to almost coremoid; conidiophores that are clavate, rarely geniculate, and longer (40.0–125.0 µm); and obclavato-cylindric, longer conidia (20.0–70.0 µm).

Phaeoramularia papaveris is also very similar to *Ramularia chelidonii* (Jacz.) Karak. (Vassiljevsky & Karakulin 1937) on *Chelidonium japonicum* Thunb. (*Papaveraceae*), but *R. chelidonii* has hyaline conidiophores and conidia, with the conidia being ellipsoid (-ovoid), subcylindric, and wider (4.0–6.5 (–8.0) µm).

Phaeoramularia papaveris is the first species of *Phaeoramularia* reported on a plant of *Papaveraceae*.

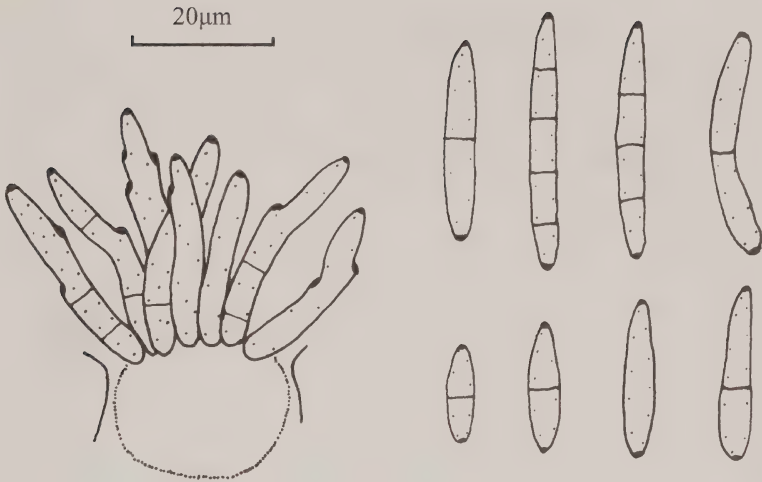


Fig. 1 *Phaeoramularia papaveris* (HMAS 143915).
1. Conidiophores; 2. Conidia

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Phoma adonidicola sp. nov. on *Adonis palaestina*

YAN LI QI WANG¹ RU-HONG MEI

wangqi@cau.edu.cn

Department of Plant Pathology, China Agricultural University
Beijing 100094, China

GUO-ZHONG LU¹

luguozhongg@hotmail.com

Institute of Bio-Resources and Environment, Dalian Nationalities University
Dalian 116600, China

Abstract—*Phoma adonidicola*, described in this paper, is a virulent parasite on *Adonis palaestina*. It is characterized by its rapidly growing colony, abundant sclerotia and large chlamydospores on diagnostic media, and its thin pycnidial wall.

Key words—pycnidium, conidium, culture

During investigation of plant diseases on the introduced adonis (*Adonis palaestina*) in Tongliao, Inner Mongolia, China in 2004, a stem spot disease was found to be widespread and causing serious damage. After a comprehensive investigation the fungus was found to be an undescribed species.

Phoma adonidicola Yan Li, Q. Wang & G. Z. Lu, sp. nov.

Figs.1-6

MYCOBANK #: MB510335

Maculis ellipsoideus vel irregularis, primo pallide brunneae, demum atro-brunneae. Pycnidia solitaria vel gregaria, immersa vel semi-immersa, demum erumpentibus, glabra, globosa vel subglobosa, 115-180µm diam, brunneae. Paries cellularum textura angularis composito, 2-3 cellulae crassae, ostiolata. Cellulae conidiogenae enteroblasticae, phialidicae, ampulliformes, hyalinae. Conidia hyalina, ellipsoideae ad oblongae, aseptatae, 5-7.5×2.0-2.5µm, 2 guttula polaris.

Coloniae in agaro avenae celerito, post 7 dies 20-22°C ad 7.6 cm diam, olivaceo-viridae ad olivaceo-nigrae. Pycnidia globosa ad subglobosa, ostiolata, papillata, 100-150µm diam. solitaria ad gregaria, glabra, paries cellularum texura angularis, 2-3 cellulae crassae.

¹Corresponding authors

Conidia ellipsoideae ad oblongae, aseptata, 2-guttulae polaris, hyalinae, 5.0-6.25 × 2.5-3.0 μm. Chlamydospora unicellula, intercalara, solitaria vel cateniformae, subglobosa vel ellipsoideae, olivaceae, intra olivaceae cinereae guttulae, maximum partem 12.5-20 μm diam. Sclerotia abunda in agaro, globosa ad irregulares, superficiales, atrobrunnea vel nigra, 50-100 μm diam.

Etymology: *adonidicola*, in reference to the host plant genus.

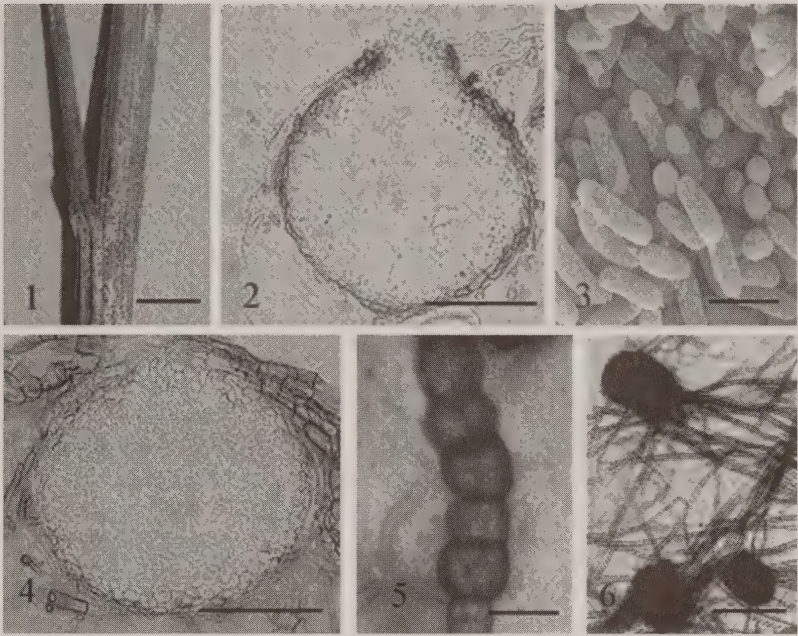
Symptom: The disease mostly occurred on stems and petioles of the plants, and subsequently developed on roots and leaves. The pathogen could infect the petioles of the young seedlings and soon spread to the stems. Under humid conditions the stems and petioles of the infected plants were covered with many lesions. The lesions firstly were light yellow-brown with a yellow halo and elliptical or irregular in shape, and later turned blackish brown. The lesions coalesced, resulting in early death of the plant. Many black conidiomata were produced on the lesions (Fig. 1).

Morphology: In vivo the conidiomata are pycnidial (Fig. 2), globose or subglobose, immersed or semi-immersed, sometimes becoming erumpent, solitary or in clusters, glabrous, 115-180 μm diam, yellow brown or brown, with walls of thin-walled, pale to medium brown textura angularis, 2-3 cells thick, and a single ostiole. Conidiophores absent. Conidiogenous cells enteroblastic, phialidic, integrated or discrete, ampulliform, hyaline, smooth. Conidia hyaline, ellipsoidal to oblong, aseptate, thin-walled, usually with two polar guttules, 5-7.5 × 2.0-2.5 μm (Fig. 3).

Colony on OA at 20-22°C growing rapidly, attaining around 70 mm diam after 7 days, regular, olivaceous greenish to olivaceous black, often with darker concentric zones; aerial mycelium sparse, white, floccose, reverse similar, slightly more grey. NaOH spot test in the margin demonstrates an oxidation reaction: a blue green discoloration of the agar, changing to brown red. On PDA felted white aerial mycelium, colony grayish green, attaining 65-70 mm diam, the reverse brownish red.

In vitro pycnidia (Fig. 4) globose to subglobose with one ostiole, slightly papillate, 100-150 μm diam., solitary or confluent, glabrous, thin-walled with 2-3 layers of textura angularis. Conidia ellipsoidal to cylindrical, aseptate, with 2 polar guttules, hyaline, 5.0-6.25 × 2.5-3.0 μm. Chlamydospores (Fig. 5) unicellular, intercalary, solitary or in chains, subglobose to ellipsoidal, olivaceous with olivaceous grey guttules, mostly 12.5-20 μm diam. Sclerotia abundant on agar, globose to irregular, superficial, dark brown to black, 50-100 μm (Fig. 6).

Holotype: on *Adonis palaestina* Boiss., Tongliao, Inner Mongolia, China, 20 September, 2004, Yan Li (IBE 002001). **Isotype:** dried cultures (IBE 002002, 002003). The type specimens and cultures are preserved in Mycological Herbarium of Dalian Nationalities University.



Figs. 1-6 *Phoma adonidicola*. 1. Pycnidia on stem. 2. Vertical section of pycnidium on stem. 3. Conidia in a pycnidium on stem (SEM). 4. Vertical section of pycnidium on OA. 5. Chlamydospores on OA. 6. Sclerotia on OA.

Bars: 1=5 mm; 2=50 μ m; 3=5 μ m; 4=50 μ m; 5=10 μ m; 6=50 μ m.

Note: The present fungus belongs to section *Phoma* of the genus *Phoma* according to Sutton (1980) and Boerema et al. (2004). However it differs from *P. eupyrena* Sacc. and *P. pereupyrena* Gruyter et al. It is characterized by its fast growing colony on OA and larger conidia by comparison with *P. eupyrena*, its pycnidial wall is composed of only 2-3 layers of cells, while that of *P. pereupyrena* consistent of 5-8 layers of cells. Its chlamydospores are much larger than those of the other two species. *P. eupyrena* and *P. pereupyrena* were not illustrated with sclerotia on various media. The authors also conducted the comparison between the studied species and *P. medicaginis* Malbr. & Roum. and *P. exigua* Desm., the latter two species are characterized by some 1-2 septate conidia.

Acknowledgements

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**A new species of *Phyllachora* on *Peltastes peltatus* (Apocynaceae)
from Minas Gerais, Brazil**

OLINTO L. PEREIRA & ROBERT W. BARRETO

oliparini@ufv.br

Departamento de Fitopatologia, Universidade Federal de Viçosa
Viçosa, Minas Gerais, 36570-000, Brazil

Abstract—A tar-spot fungus, found associated with *Peltastes peltatus* (Apocynaceae), was identified as a previously unknown *Phyllachora*. This new fungal species is named *Phyllachora peltaticola* and is described and illustrated herein. It represents the first fungus to be described in association with a plant in the genus *Peltastes*.

Key words—*Ascomycota*, biodiversity, *Phyllachoraceae*, taxonomy, tropical fungi.

Introduction

Fungi belonging to *Phyllachora* Nitschke ex Fuckel are characterized by the development of perithecia beneath a subcuticular or epidermal clypeus in the host tissue and cause tar spots on plants belonging the *Magnoliopsidae* (Cannon 1991, 1996, 1997; Cannon & Evans 1999) and *Liliopsidae* (Parbery 1967, Cannon 1997). In this genus are included 500 spp., according to Kirk et al. (2001), with a predominantly tropical distribution. It is wholly comprised of biotrophic species and there is evidence of close coevolution between these fungi and their host plants (Cannon 1994). There are few examples of members of *Phyllachora* known to be capable of causing significant crop losses, eg: *Phyllachora lespedezae* (Schwein.) Sacc. on *Lespedeza* (Lopez-Rosa & Sherwood 1966, Cannon 1991) and *Phyllachora maydis* Maubl. on *Zea mays* L. (Parbery 1967).

The families *Arecaceae*, *Asteraceae*, *Cyperaceae*, *Fabaceae*, *Moraceae*, *Myrtaceae*, *Melastomataceae* and *Poaceae* are known to serve as hosts to many species of *Phyllachoraceae* (Cannon 1997). Although the *Apocynaceae* s. l. is a large family having a pantropical distribution, the number of *Phyllachora* known to have members of this family as hosts is limited. For Brazil, Mendes et al. (1998) listed only two species in association with *Apocynaceae*: *Phyllachora maculicola* Syd. & P. Syd. on *Aspidosperma* sp. and *Phyllachora aspidospermatis-tomentosi* R.B. Medeiros & Dianese on *Aspidosperma tomentosum* Mart. Viégas

(1961) reported nine species of *Phyllachora* on the *Apocynaceae* for South America and the Caribbean. A possible explanation for the somewhat limited number of species known to parasitize members of the *Apocynaceae* may be the limited exploration of neotropical mycological diversity.

The Reserva Florestal Mata do Paraíso (RFMP) is a protected area representing the semideciduous tropical montane forest (a sub-type of the Atlantic tropical rainforest) that belongs to the Universidade Federal de Viçosa (municipality of Viçosa, state of Minas Gerais, Brazil). During a floristic survey (September 2002), samples of the liana *Peltastes peltatus* (Vell.) Woodson (*Echiteae*, *Apocynaceae*) were collected. It was later observed that some leaves of this specimen showed tar spot symptoms associated with an undescribed species of *Phyllachora*. This work describes and illustrates the new species as part of an ongoing program of surveying and describing the mycodiversity in the state of Minas Gerais.

Material and Methods

Selected leaves showing tar-spot symptoms were taken from the botanical sample originally collected, photographed, and dried in a plant press. Sections of fresh material of infected leaves were prepared with a freezing microtome (Leitz, Kryomat). The sections were mounted in lactophenol and the fungal structures were later examined, measured and illustrated with a light microscope fitted with a camera lucida (Olympus, BX 50).

Taxonomic Description

Phyllachora peltaticola O.L. Pereira & R.W. Barreto, sp. nov.

FIGS 1-5

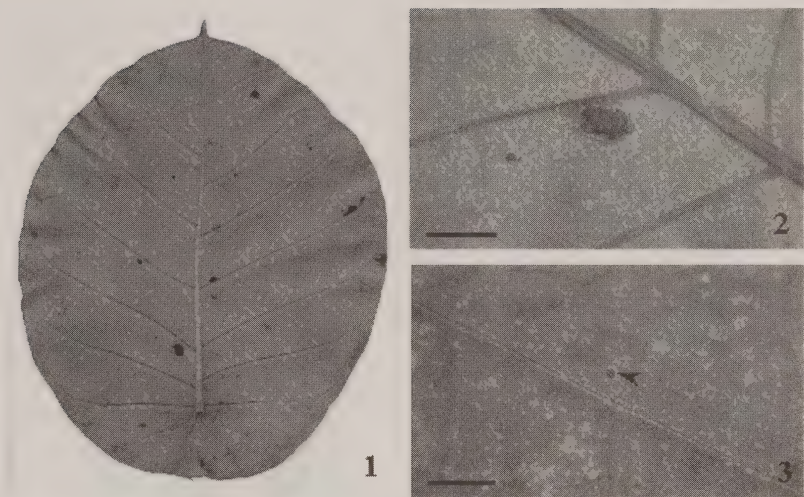
MycoBank 500207

Epigena stromata nigra et nitida 1.0-1.5 mm diam., *circularis*, *hypogyna stromata nigra et nitida* 2.0-9.0 mm diam. *irregularis*. *Ascomata clypeata*, 198.0-257.0 µm lata, 232.0-247.0 µm alta, *immersa*, *subepidermalia*. *Asci cylindrici*, *octospori*, *unitunicati*, 100.0-123.0 × 10.0-11.0 µm. *Paraphyses hyalinae*. *Ascosporae fusiforme-ellipsoideae hyalinae*, 23.0-37.0 × 6.0-7.0 µm, *unicellulares*. *Anamorphosis non observata*.

Etymology: inhabiting *Peltastes peltatus* (*Apocynaceae*).

Holotype: BRAZIL. Minas Gerais, Viçosa, Reserva Florestal Mata do Paraíso, on leaves of *Peltastes peltatus*, 29. VIII. 2002, Oct., G. E. Valente (VIC 26501).

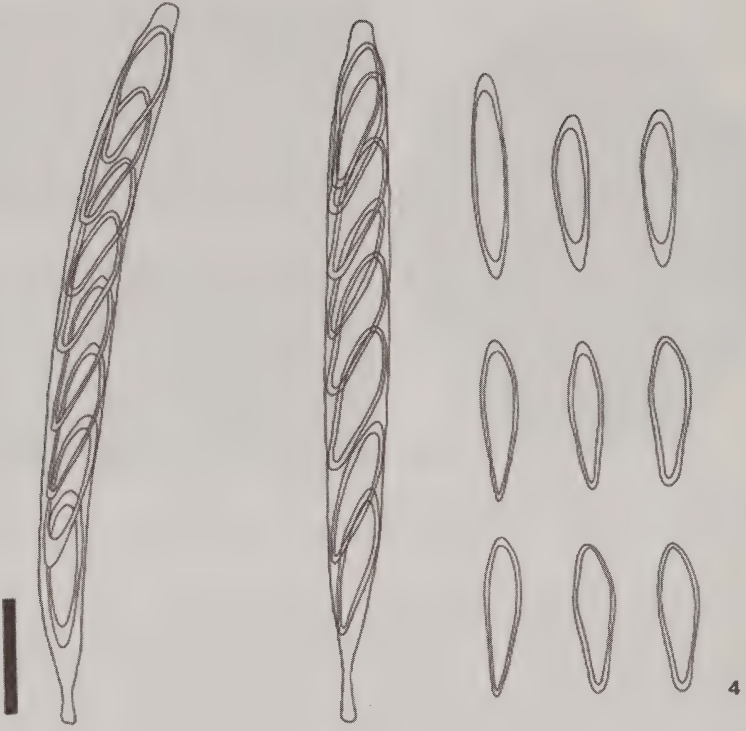
Colonies on living leaves, visible on both sides of leaves, small, black, circular with well defined border, 1.0-1.5 mm diam. adaxially; more prominent, black, elliptic to irregular in shape, 2.0-9.0 mm diam. abaxially, multiloculate, ostioles prominence indistinct. *Ascomata* immersed, isolated, subsphaerical, 198.0-257.0 × 232.0-247.0 µm, wall thickness 17.0-25.0 µm, comprising several layers of dark brown pseudoparenchymatous cells, clypeus amphigenous, 22.0-37.0 µm



Figures 1-3. *Phyllachora peltaticola* (VIC 26501). 1. Symptoms on infected leaves of *Peltastes peltatus*. 2. Irregular well developed abaxial tar spot. 3. Circular small adaxial tar spot (arrowhead). Bar = 10 mm.

thick. *Dehiscence* ostiolate, circular. *Hamathecium* composed of paraphyses, cylindrical, slightly longer than asci, aseptate, thin walled, hyaline, smooth, unbranched, persistent. *Asci* unitunicate, 8-spored, cylindrical, $100.0\text{--}123.0 \times 10.0\text{--}11.0 \mu\text{m}$, thin-walled at maturity, apex undifferentiated. *Ascospores* uniseriate, overlapping, fusiform, rarely ellipsoidal, often acute at one end and rounded at the other, $23.0\text{--}37.0 \times 6.0\text{--}7.0 \mu\text{m}$, aseptate, wall thickness variable, hyaline, smooth. Anamorph not observed.

Remarks — *Phyllachora peltaticola* is similar to six other species parasitizing members of the *Apocynaceae*: *Phyllachora ajrekarii* Syd. & P. Syd., *Phyllachora dischidia* Syd. & P. Syd., *Phyllachora gloriana* C. A. Pearce et al., *Phyllachora forsteroniae* (Rehm) Petr., *Phyllachora pressa* Syd. and *Phyllachora tabernaemontanae* F. Stevens in that they all have an amphigenous clypeus. However, *P. peltaticola* is morphologically distinct from these species by having a circular and less prominent clypeus on the adaxial leaf surface (Figure 1). *Phyllachora dischidia* has a clypeus having a similar morphology on both sides of the leaf whereas *P. ajrekarii* and *P. gloriana* have a clypeus that is more prominent adaxially. *P. peltaticola* is more similar to *P. gloriana* by having ascospores of similar size and shape, and a perithecial wall of similar thickness. *P. peltaticola* is distinguished from *P. gloriana* by prominence and shape of the adaxial clypeus and the absence of a mucilaginous ascospore sheath in the new species, a feature clearly observed on *P. gloriana*. Additionally, *P. peltaticola* and



P. gloriana have hosts belonging to different tribes in the family *Apocynaceae* and have a very disjunct geographical distribution. The latter is restricted to *Tylophora benthamii* Tsiang (*Asclepiadeae*, *Apocynaceae*), a species endemic to tropical and subtropical areas of eastern and northern Australia (Pearce et al. 1999).

The biotrophic nature of most of *Phyllachora* spp., as some other genera belonging to the *Phyllachorales*, means that host specificity has played a major role in the species definition (Cannon 1991, 1997; Silva-Hanlin & Hanlin 1998). A general literature search for records of species of *Phyllachora* and other fungi associated to the genus *Peltastes* yielded no records. *Phyllachora peltaticola* is therefore the first fungal species described on a member of this plant genus. The literature search did not show any species of the genus *Phyllachora* associated to any host genus belonging to the tribe *Echiteae*, *Apocynaceae* (Endress & Bruyns 2000). Therefore, this is the first record of a *Phyllachora* species in this tribe of the *Apocynaceae*.

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Figures 4-5. *Phyllachora peltaticola* (VIC 26501). 4. Unitunicate eight-spored asci and hyaline aseptate ascospores. 5. Clypeate immersed ascomata. Scale bars: 20 µm and 100 µm respectively.

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***Chroodiscus himalayanus*, a new species from India**

S. NAYAKA & D.K. UPRETI*

*upretidk@rediffmail.com

*Lichenology Laboratory, National Botanical Research Institute
Rana Pratap Marg, Lucknow – 226 001, India*

Abstract—*Chroodiscus himalayanus* is described as new to science. The new species has transversely septate, acicular ascospores with a bead-like end cell.

Key words—*Thelotremataceae*, chroodiscoid, crustose lichen

Introduction

India has a rich diversity of thelotremataceous lichens distributed in tropical forests, especially in the Western Ghats region of south India. About 180 species of common thelotremataceous lichens, belonging to the genera *Myriotrema*, *Ocellularia* and *Thelotrema*, are known from the Indian subcontinent (Awasthi 2000). Sethy & Patwardhan (1987) and Singh (1979) described two foliicolous species of *Chroodiscus* from the Andaman and Nicobar Islands. One of our recent collections from Himalayas proved to be an interesting species of corticolous *Chroodiscus*, which is described here as new to science.

Materials and methods

The specimens were examined morphologically, anatomically and chemically. Thin hand-cut sections of apothecia and thallus were mounted in plain water, cotton blue, 5% KOH and iodine solution and observed under a compound microscope. For chemical spot tests the usual reagents of K, C and PD were used. TLC was performed in solvent system A following Walker & James (1990).

Chroodiscus himalayanus* Nayaka & Upreti, sp. nov.*Fig. 1-5**

Mycobank # MB510460

Thallus typice corticola, tenuissimus vel evanescens, plerumque circa apothecia plus minusque restrictus, cinereo-viridis vel olivaceo-viridis, haud limitatus, ecorticatus, prothallo nullo, algis ad generam *Trentepohliam* pertinentibus, in parte basali thalli sitis. Apothecia dispersa, primum in thallo immersa, demum erumpentia, orbicularia, 1.0–2.5

mm lata, adnata vel basim constricta; disco plano, aurantiaco-brunneis, laevis, nitido, epruinoso, plus minusque aperto, margin albido, 2–5 lobulato. Excipulum proprium hyalinum, ad basim dimidium, grandis crystalliferum; periphysibus parvis, distinctis. Epihymenium hyalinum vel luteolum, I+ caerulescens, deinde vinascent. Hymenium hyalinum, 90–120 μm crassum, oleoso-inspersum, I+ caerulescens, deinde vinascent. Subhymenium et hypothecium hyalinum, oleoso-inspersum, I+ caerulescens, deinde vinascent. Asci 2–3 spori, cylindrici, 85–95(–110) μm logi et 8–10 μm lati, parietis, K–, I–, at lumine I+ pallide lutescente vel aurantiascente. Ascospores hyalinae, non-halonatae, 40–78(–85) longae et 3–5 μm latae, septis transversalibus ad 15–25 (–30), aciculares, extremis cellulis moniliformis, I+ pallide lutescentes usque ad aurantiaco-lutescentes. Paraphyses simplices, tenues, cohaerentes, K–, at I+ caerulescentes, deinde vinascentes.

Etymology: From the Himalayas, referring to the type locality.

Holotypus: INDIA, Himachal Pradesh, Kullu district, Great Himalayan National Park, Sainj Wildlife Sanctuary, Shakti, 2200 m, on bark, 06-06-2004, R. Srivastava 04-003228 (LWG–holotype).

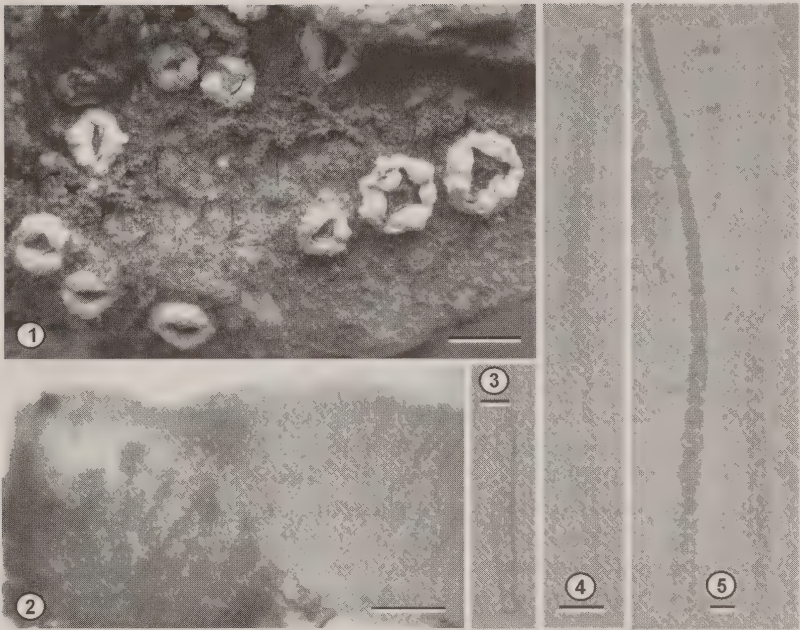
Thallus corticolous, crustose, thin to evanescent, ecorticated, smooth, rather patchy, usually restricted to around the apothecia, grey-green to olive-green, not delimited; photobiont *Trentepohlia*, occurring in the basal part of thallus; prothallus absent.

Ascomata apothecia, scattered, rarely 2–3 confluent, at first $\pm$ immersed in the thallus, soon emerging through irregular cracks, roundish, 1.0–2.5 mm in diam., adnate, constricted at the base when mature; disc plane to concave, orange-brown, smooth, shiny, epruinose, usually completely exposed; margin whitish, 2–5 lobate, 0.5–1.0 mm thick, in older apothecia exfoliating, developing radial fissures and dividing into 2–3 lamellae. Proper exciple in section hyaline, densely inspersed with calcium oxalate crystals, dimidiate at base, K–, I–, sometimes in mature apothecia forming with a supportive layer of bark cells; periphyses distinct; epihymenium hyaline to slightly yellowish, K–, I+ blue turning wine red; hymenium hyaline, 90–120 μm high, K–, I+ blue turning wine red, inspersed with oil globules; subhymenium and hypothecium hyaline, inspersed with oil globules, K–, I+ blue turning wine red. Asci 2–3 spored, cylindrical, 85–95(–110) $\times$ 8–10 μm , K–, I– or I+ with contents turning yellow to yellowish orange; ascospores hyaline, non-halonate, transversely 15–25(–30) septate, acicular, with basal end cell rounded, 40–78(85) $\times$ 3–5 μm , K–, I+ yellow to golden yellow; paraphyses, mostly simple, coherent, K–, I+ blue turning wine red.

Chemistry: Thallus K–, C–, KC–, P–. No lichen substances in TLC.

Distribution and ecology: At present *C. himalayanus* is known only from its type locality, in the north Himalayas, where it is found growing luxuriantly on tree trunks at an altitude of 2200 m.

Remarks: *C. himalayanus* is characterized by chroodiscoid apothecia with a prominent white, exfoliating margin, transversely septate, acicular ascospores,



Figure–1-5. *Chroodiscus himalayanus* (from holotype): 1. Habit; 2. L.S. of apothecia showing calcium oxalate crystals in exciple; 3. Bead like end cell; 4. Ascus; 5. Ascospores
(Bars, Fig. 1 = 2 mm, 2 = 0.25 mm, 3&5 = 5 μ m, 4 = 10 μ m).

the presence of calcium oxalate crystals in the exciple and oil globules in the hymenium. The ascospores are broader at one end and narrow gradually towards the other. The terminal cell at the broader end becomes swollen and bead-like in appearance. The hymenium exhibits a peculiar reaction with iodine by gradually turning from blue to wine red, while the asci and ascospores remain yellow to yellowish orange and yellow to golden respectively. Such a character is unique for the genus though the colour changes in the immature ascus contents or ascospores are observed (Kantvilas & Vězda 2000).

Among the recognized corticolous *Chroodiscus* species, *C. himalayanus* is close to *C. minor* Kantvilas & Vězda, in having transversely septate ascospores, and a similar thallus and apothecial morphology. However, *C. minor* differs by its smaller apothecia (0.5–1.0 mm wide) and transversely up to 7-septate, ellipsoid to fusiform ascospores. The other corticolous *Chroodiscus* taxa have muriform ascospores (Kantvilas & Vězda 2000).

According to the new generic classification of the *Thelotre mataceae* (Frisch 2006, Frisch & Kalb 2006) the genus *Chroodiscus* is now restricted to the foliicolous species, being characterised by a non-periphysate proper

exciple, truly thin-walled (without any, though faint, lateral thickenings of the septa), small, hyaline, I- ascospores, a low hymenium and rather easily separated paraphyses. Another (monotypic) genus with thin-walled, hyaline, I- ascospores, *Acanthotrema* Frisch (*A. brasilianum* (Hale) Frisch) differs by the presence of periphysoids (with spiny tips) and rigid, rather strongly agglutinated paraphyses with spiny end-cells. This species is corticolous. The third genus with chroodiscoid apothecia, *Chapsa* A. Massal., in the present circumscription appears to be still heterogeneous. It accommodates all corticolous species with thick-walled (though sometimes very indistinct) ascospores (hyaline or brown, I+ or I-), a rather rigid type of the paraphyses often with moniliform or branched tips, and periphysoids (sometimes indistinct). This genus largely complies with *Thelotrema* subgen. *Asteristion* of Matsumoto (2000). However, the new species described here seems not to fit in any of these genera. From *Chroodiscus* and *Acanthotrema* it differs in the large, acicular ascospores, which are of a reduced thick-walled type, and from *Chroodiscus*, additionally by the presence of periphysoids. It differs from *Chapsa* species in having large, acicular ascospores, the large number of crystals in the lateral proper exciple, which is rare in chroodiscoid species of *Thelotremataceae* or in any of the other species with periphysoids and the hymenium turning blue to wine red in iodine. The colour change in hymenial matrix is also rare in species of the *Thelotremataceae*. Some characters of *C. himalayanus* like the large, rather thin-walled acicular ascospores, the large number of crystals in the lateral proper exciple and the hymenium turning blue to wine red in iodine even hint on a possible relationship with the *Stictidaceae* (Sherwood 1977).

The taxonomy of the chroodiscoid *Thelotremataceae* is still not finally settled and further changes in the delimitation of genera (including the description of additional new genera) are to be expected (personal communication, A. Frisch). However, following the old taxonomy and considering the taxonomic difficulties outlined above, *C. himalayanus* is described as a new species here.

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NATS truffle and truffle-like fungi 14: *Pachyphloeus austro-oregonensis*, a new species from southern Oregon

JONATHAN L. FRANK¹, DARLENE SOUTHWORTH¹ & JAMES M. TRAPPE²

frankjon@sou.edu

¹*Department of Biology, Southern Oregon University
1250 Siskiyou Blvd. Ashland, OR 97520-5071, USA*

²*Department of Forest Science, Oregon State University
Corvallis, OR 97331-5752, USA*

Abstract — A new truffle species, *Pachyphloeus austro-oregonensis* (Pezizaceae, Pezizales), is described from southern Oregon, USA. This hypogeous species is associated with *Quercus garryana*.

Key words — hypogeous fungi, oak woodland, mycorrhizas, mycophagy, DNA

Introduction

Research on the biodiversity of ectomycorrhizal fungi in Oregon white oak woodlands has included a survey of hypogeous sporocarps at Whetstone Savanna Preserve in southern Oregon (Valentine et al. 2004, Frank 2005, Frank et al. 2006). The site is a remnant woodland of *Quercus garryana* Dougl. ex Hook. interspersed with shrublands of *Ceanothus cuneatus* (Hook.) Nutt. Eighteen species of hypogeous fungi were collected for this survey (Frank 2005, Frank et al. 2006), of which 13 were *Ascomycota* and 5 *Basidiomycota*. Six of the *Ascomycota* were in the family *Pezizaceae*, two of these in the genus *Pachyphloeus*: *P. citrinus* and *P. austro-oregonensis* sp. nov. Recent molecular analysis suggests that the Genus *Pachyphloeus* forms ectomycorrhizal mutualisms (Tedersoo et al. 2006).

In addition to consulting keys, previously published descriptions of species in the genus *Pachyphloeus* and type collections of all previously described species, molecular methods were used to compare DNA sequences from field collections to those of hypogeous fungi in GenBank, www.ncbi.nlm.nih.gov (Castellano et al. 1989, Gardes & Bruns 1993, Frank 2005, Frank et al. 2006).

Spores from *Pachyphloeus austro-oregonensis* were present in the fecal pellets of two small mammals, *Microtus californicus* and *Peromyscus maniculatus*, trapped

at the research site (Frank 2005, Frank et al. 2006). These rodents provide this truffle with a spore dispersal mechanism.

Materials and methods

Whetstone Savanna Preserve (42°25'N, 122°54'W), owned by The Nature Conservancy, is on an alluvial plain near the Rogue River in southern Oregon. Precipitation is 40-50 cm of rainfall per year. Hypogeous sporocarps were collected by raking the ground with a short-tined garden cultivator beneath and around *Quercus garryana* (Oregon white oak, Garry oak) weekly from April through June, 2003 through 2005, and less frequently in other months. Leaf litter and soil were examined for sequestrate sporocarps. Specimens were described the same day (Weber et al. 1997). Sporocarps were photographed in the field with a Canon EOS digital SLR camera and in the lab under a Leica MZ75 dissecting microscope with a SPOT RT Color camera (Diagnostic Instruments, Inc.) and under a Leica DMLB compound microscope with a SPOT QE insight camera. Microscopic characters were described from razor-blade sections of fresh specimens mounted in water, 5% aqueous KOH, and Melzer's reagent. Collections were deposited in the herbaria of Southern Oregon University (SOC), Oregon State University (OSC) and San Francisco State University (SFSU). Type specimens of all described species in the genus *Pachyphloeus* were examined at the Oregon State University herbarium.

Small mammals were captured in Sherman live traps around Oregon white oak and buck brush where truffles had been collected at Whetstone Savanna Preserve (Frank 2005, Frank et al. 2006). For visual spore identification, slides of fresh fecal pellets were stained with Melzer's reagent and viewed with a compound microscope.

DNA was extracted from sporocarps and fecal pellets in CTAB buffer with chloroform and amplified in polymerase chain reactions (PCR) with fungal specific primers ITS1F and ITS4 (White et al. 1990, Gardes & Bruns 1993). Molecular data were obtained by sequencing of the internal transcribed spacer (ITS) region, including ITS1, the 5.8S ribosomal DNA gene and ITS2. PCR products were cleaned in Montage PCR Centrifugal Filter Devices (Millipore Corporation). PCR products from fecal pellets were cloned with P-Gem-T Vector System II (Promega). Clean PCR products were prepared for sequencing with BigDye Terminator Ready Reaction Mix and sequenced by an ABI 310 Genetic Analyzer (Applied Biosystems). Sequences were edited with Chromas 1.45 (McCarthy 1998) and compared to other fungal DNA sequences in GenBank with BLAST (Altschul et al. 1990). All available DNA sequences from *Pachyphloeus* spp. were aligned and compared visually with ClustalX (Thompson et al. 1997). Sequence data for *P. austro-oregonensis* are available in GenBank (AY830854).

Taxonomic description

***Pachyphloeus austro-oregonensis* J. L. Frank & Trappe sp. nov.**

Figures 1-3

Mycobank# MB510569

Ascomata subglobosa, *ptychothecia*, 1-2.5 cm lata. *Peridium* verrucosum, purpureobrunneum, in glebam invaginatam atque canales loculos paginis externis continuis formantes. *Gleba* venis labyrinthis hymeniis aureis. *Asci* 220-360 x 18-28 μ m. *Paraphyses* 8-13 μ m latae. *Sporae* globosae, hyalinae, (10-) 12-16 (-18) μ m, ornamenta virgarum aggregatarum includentes. *Typus* J. L. Frank 775 (SOC).

Etymology: Latin, *austro-* (southern) and *-oregonensis* (Oregon), “from southern Oregon.”

Ascomata subglobose to irregular ptychothecia 1–2.5 cm broad. **Peridium** verrucose, purple-brown with a pallid to pink inner layer and invaginated into the gleba as narrow canals that form thin, verrucose, interior chambers continuous with the outer surface. **Gleba** with labyrinthiform veins lined by golden-yellow hymenia; veins, open or with opposing hymenia pressed together, separated by grey-brown sterile tissue. **Ascomatal base** sometimes giving rise to a root-like, white, tapering hyphal mass 10–13 x 2–3 mm. **Odor** mild. **Taste** not recorded.

Peridium 500–950 μm thick, with two layers: **outer layer** a *textura angularis* 200–400 μm thick of inflated, irregular to isodiametric cells 15–40 μm broad, with light brown walls at the peridial surface grading to hyaline toward the interior; **inner layer** 300–550 μm thick, of hyaline cells 4–8 μm broad and of various lengths, contorted and irregularly arranged as a *textura intricata*. **Trama** 50–200 μm thick, of cells 4–6 μm broad running parallel. **Subhymenium** 20–50 μm thick, a *textura intricata* with many isodiametric cells 4–10 μm broad. **Asci** in tight palisades lining the glebal canals, cylindrical, 220–360 x 18–28 μm , with a forked base, occasionally bent, with 8 uniseriate to incompletely biseriate spores, amyloid. **Paraphyses** septate, 8–13 μm broad with clavate tips, equal to or extending up to 60 μm beyond the asci. **Ascomatal base** a *textura intricata*, of cells 8–18 x 2–4 μm and as loose septate hyphae at the exterior surface.

Spores globose, hyaline (10–) 12–16 (–18) μm broad including the ornamentation of crowded rods 1–2.5 x 0.5 μm ; **spore walls** 1–2 μm thick.

Habit, Habitat and Season: hypogeous; associated with *Quercus garryana* in southern Oregon, 400 m elevation, Mediterranean climate with dry summers and less than 50 cm annual precipitation. Sporocarps fruit below leaf litter in top 2–5 cm of mineral soil, May–June. All collections of this new species are from the Whetstone Savanna Preserve, north of Medford, Oregon.

Collections examined: HOLOTYPE— UNITED STATES. OREGON: Jackson Co. North of MEDFORD, Whetstone Savanna Preserve (42°25'N, 122°54'W), J. L. Frank, 4 June 2004, 775 (SOC; isotypes: SFSU, OSC 112205, GenBank AY830854). PARATYPES: UNITED STATES. OREGON: Jackson Co. North of MEDFORD, Whetstone Savanna Preserve J. L. Frank 1 June 2004, 761 (SOC, OSC112204), and 4 June 2004, 774 (SOC).

COMMENTS – The nomenclature of this new species reflects that it was collected in southern Oregon with the support of Southern Oregon University. Additionally, the interior morphology of folded golden hymenia mirrors the landscape of southern Oregon with its golden dry hills. While the sporocarp of *Pachyphloeus austro-oregonensis* is a ptychothecium, its glebal foldings can be so dense as to resemble a stereothecium.

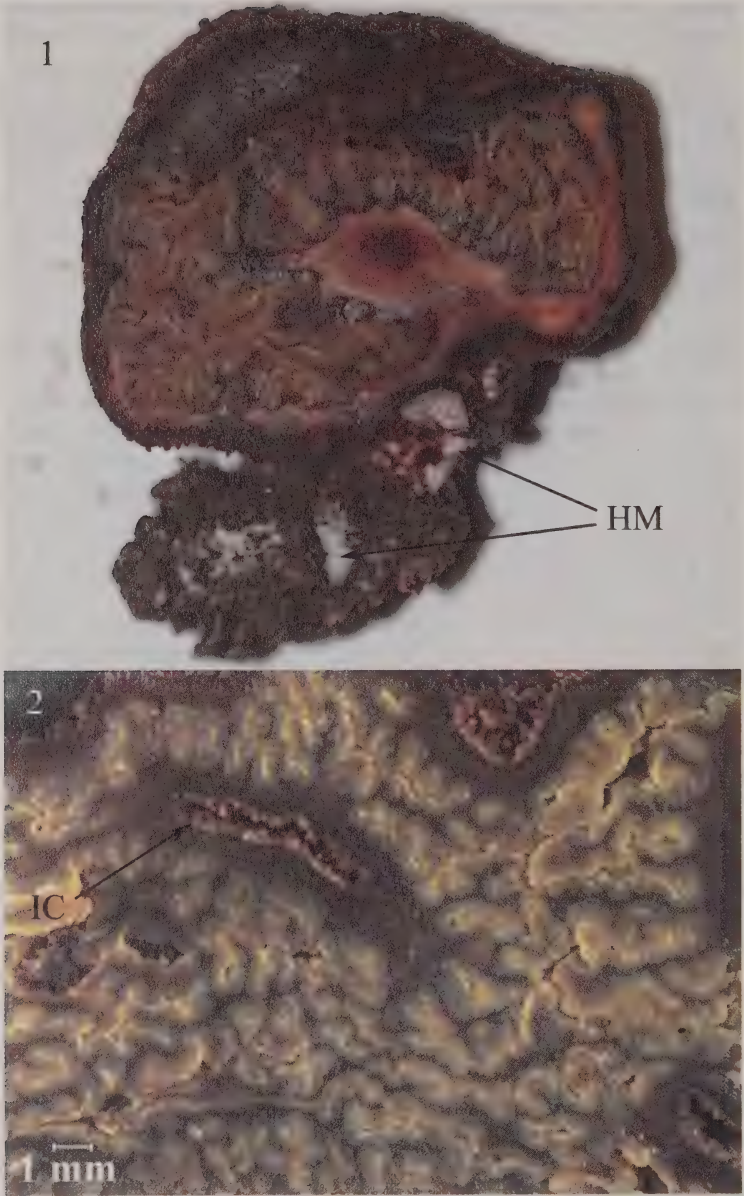


Figure 1. *Pachyphloeus austro-oregonensis* (SOC775) showing basal hyphal mass (HM). Figure 2. *P. austro-oregonensis* (SOC774) showing an invaginated canal (IC), bar = 1mm.



Figure 3. *P. austro-oregonensis* spores in ascus.

Pachyphloeus austro-oregonensis differs from *P. lateritius* Fogel & States in having smaller spores with taller ornamentation, and longer, cylindrical asci. *P. melanoxanthus* (Berk.) Tul. & C. Tul and *P. virescens* Gilkey have more broadly ellipsoid asci. *P. citrinus* Berk. & Broome, which fruits under oaks, and *P. thysellii* Colgan & Trappe, which fruits under *Pseudotsuga menziesii*, have elliptical to subglobose asci and solid glebae. *P. virescens* has a dull green external surface, while the exterior surface of *P. austro-oregonensis* is purple-brown and verrucose. *P. conglomeratus* Berk. & Broome has an external surface without distinct warts and also asci that stain in Melzer's. In Melzer's, asci of *P. austro-oregonensis* stain weakly blue-green to vividly blue and immature asci stain orange.

The hyphal mass at the ascomatal base was observed on one fruiting body (SOC775) of the four fruiting bodies collected and examined. In all of the collections, while many asci had fully developed spores with ornamentation, many asci were empty or had a cluster of smaller developing spores lacking ornamentation. Thus the specimens, all collected in June, may not have been fully mature. While no distinct odor was noted, fully mature sporocarps may exude a characteristic aroma. A columella-like structure was visible in one specimen (SOC775), as shown in Fig. 1., but was not visible in the other specimens.

Obtaining clean sequence data from *Pachyphloeus austro-oregonensis* was notably problematic. Despite removing interior regions of clean gleba and extracting DNA under sterile conditions, PCR reactions often yielded multiple bands. After many attempts, a relatively short segment (486 bp) was clear enough to analyze and deposit in GenBank. This segment included the complete sequence for the 5.8S ribosomal DNA gene and partial sequences for ITS regions 1 and 2.

Spores of *P. austro-oregonensis* were observed in fecal pellets of two small mammals, *Microtus californicus* and *Peromyscus maniculatus*, trapped at the Whetstone Savanna site (Frank 2005, Frank et al. 2006). This observation was supported by molecular analysis. One ITS sequence cloned from fungal DNA in the fecal pellet of *Microtus californicus* most closely matched the ITS of *P. austro-oregonensis* with 452 of 486 identities in common.

Ecology

Hypogeous fungi are common in Mediterranean climates, having evolved under selection pressures for survival in warm, dry climates (Montecchi & Sarasini 2000, Trappe & Claridge 2005). Subterranean fruiting strategies conserve moisture and require alternatives to the aerial spore dispersal mechanism common to epigeous mushrooms. Animals, attracted by volatile aromatics produced by the hypogeous fruiting bodies at maturity, dig them up, consume them, and disperse the spores in their feces (Claridge & Trappe 2005).

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***Monodictys arctica*, a new hyphomycete from the roots of *Saxifraga oppositifolia* collected in the Canadian High Arctic**

MELISSA J. DAY¹*, CONNIE FE C. GIBAS¹, KEI E. FUJIMURA²,
KEITH N. EGGER² & RANDOLPH S. CURRAH¹

mjday@ualberta.ca

¹ Department of Biological Sciences, University of Alberta,
Edmonton, AB, T6G 2E9, Canada

² Ecosystem Science and Management Program,
University of Northern British Columbia, Prince George, BC, V2N 4Z9, Canada

Abstract—*Monodictys arctica* sp. nov. is described on the basis of nine isolates obtained from the roots of eight separate collections of *Saxifraga oppositifolia* from Ellesmere Island, Nunavut, Canada. Conidia are multicelled, smooth, darkly pigmented, and globose, oblong, ellipsoidal, or pyriform to irregularly shaped or dichotomously branched, consisting of a blastically produced basal cell and a distal proliferation of up to 24 cells arising from meristematic growth. Analyses of SSU and ITS sequences indicate the species is unique but has an affinity to the loculoascomycete taxon *Leptosphaeria dryadophila*.

Key words —endophyte, DSE, taxonomy

Introduction

The surfaces and cortices of fine roots are usually heavily infected with darkly pigmented, septate hyphae, some of which are easily isolated after surface sterilisation and grow readily in culture (Addy et al. 2005). Among the more common and widely distributed species of these “dark septate endophytes” or “DSE” are the helotialean anamorphs *Phialocephala fortinii* C.J.K. Wang & H.E. Wilcox, *Leptodontidium orchidicola* Sigler & Currah, and *Scytalidium vaccinii* Dalpé et al.

A large collection of cultures, composed predominantly of “DSE” fungi, were isolated from the roots of *Cassiope tetragona*, *Dryas integrifolia*, *Salix arctica*, and *Saxifraga oppositifolia* collected during the summer of 2000 from Alexandra Fiord, Ellesmere Island, Nunavut, Canada (78° 53'N, 75° 55'W). The plants were collected as part of an experiment to study the effects of passive

*Author for correspondence

warming using open-topped chambers (OTCs) on root-associated fungal communities. Among this collection of fungi were numerous representatives of *P. fortinii*, *L. orchidicola*, and *S. vaccinii* along with isolates of other taxa. Eight of the latter, each from separate collections of *S. oppositifolia*, were distinctive in producing irregular, multicelled, darkly pigmented conidia that were assignable to *Monodictys* (anamorphic *Dothideales*, fide Kirk et al. 2001) but did not match any described species.

Here, we provide a description of *Monodictys arctica* along with a comparison of this new species with similar ones and, using sequence data from the small subunit and internal transcribed spacer regions on the ribosomal DNA, provide an estimation of its phylogenetic position among related taxa in the Loculoascomycetes (sensu Barr & Huhndorf 2001).

Materials and methods

Specimens of *Saxifraga oppositifolia*, from OTCs and ambient plots, were harvested along with surrounding soil, placed in Ziploc® bags, and stored at 4°C until processed at the University of Northern British Columbia. Soil was loosened from roots by immersing in water for at least 24 hours at 4°C. Roots were gently cleaned with water and then collected in a 0.5 mm sieve (No. 35 USA standard testing sieve, W.S. Tyler, Inc. Mentor, Ohio, USA). Randomly selected root sections were surface-sterilized with 30% H₂O₂ following Danielson (1984) and placed on modified Melin Norkrans (MMN) agar (Marx 1969) amended with streptomycin sulphate and chlortetracycline. Plates were incubated at room temperature (20–22°C) and isolates were purified by transfer to fresh media. A 0.5 mm plug from each isolate was placed on an MMN agar slant and stored at 4°C until it was sent to the University of Alberta for identification.

Colony characteristics of the new species were based on growth on oatmeal agar [OA; 20 g oatmeal, 20 g Select agar (Invitrogen, Carlsbad, California, USA), 1 L distilled water] and potato dextrose agar (PDA; Difco Bacto). Conidial morphology was examined using an Olympus BX50 microscope and slide cultures (Kane et al. 1997) mounted in polyvinyl alcohol with acid fuchsin [APVA; 1.66 g polyvinyl alcohol (Sigma Chemicals, Oakville, Ontario, Canada), 10.0 mL lactic acid, 1.0 mL glycerine, 10.0 mL H₂O, 0.02 g acid fuchsin] or 1.5 M KOH. Conidial and conidiophore dimensions are based on 140 and 20 measurements respectively and appear in the descriptions as a range. Images of conidia and colonies were prepared using an Olympus DP12 and an Olympus C60 camera, respectively. Freehand line drawings were made based on observations made with the light microscope.

To obtain the targeted rDNA sequences, cultures were grown on PDA overlaid with a Cellophane™ sheet (UCB Films, Bridgwater, Somerset, UK). Approximately 100 mg of mycelium was scraped off the cellophane and placed in a sterilised mortar containing acid-sterilised sand. Liquid nitrogen was added and the frozen mycelium was ground to a powder with a pestle. The powder was dissolved in 1 mL of 2x CTAB [10 mL 1M Tris pH 8.0, 8 mL 0.25M EDTA, 8.7 g NaCl, 20 mL 10% CTAB (10 g CTAB, 100 mL dH₂O), 100 mL dH₂O] and 2 µL β mercaptoethanol and incubated at 65°C for 2 hours. An equal volume of 24:1 chloroform:isoamyl alcohol was added. The tubes were inverted until an emulsion formed and then centrifuged for 20 min at 14 000 rpm at room temperature.

Table 1. Provenance data for species of *Leptosphaeria* and *Decorospora* used in the parsimony analysis of the ITS DNA region.

Species	Genbank Number	Host plant
<i>Decorospora gaudefroyi</i>	AF439451	Not listed
<i>Leptosphaeria biglobosa</i>	DQ133893	<i>Brassica napus</i>
<i>L. conferta</i>	AF439459	<i>Anacyclus radiatus</i>
<i>L. doliolum</i>	U04207	Not listed
<i>L. dryadophila</i>	AF439461	<i>Dryas octopetala</i>
<i>L. maculans</i>	M96384	<i>Brassica napus</i>
<i>L. typharum</i>	AF439465	<i>Typha angustifolia</i>
<i>Monodictys arctica</i>		<i>Saxifraga oppositifolia</i>

The upper DNA-containing layer was collected and purified using a Qiaquick PCR purifying kit (QIAGEN Inc., Mississauga, Ontario, Canada). Cleaned extraction products were visualised on a 1% agarose gel stained with ethidium bromide and exposed to UV light.

The target DNA regions, the small subunit rDNA (SSU) and the internal transcribed (ITS) spacer region, consisting of complete ITS 1, 5.8 S, and ITS 2 and partial SSU and LSU DNA, were amplified using primers BMBCR (Lane et al. 1985) and NS8 (White et al. 1990) and BMBCR and ITS 4 (White et al. 1990) respectively. The PCR reaction mixture included 5 μ L 10x buffer (500 mM KCl, 100 mM Tris Base pH 8.3), 26 μ L distilled water, 3 μ L 25 mM MgCl₂, 4 μ L of dNTP (10 mM of each dNTP), 5 μ L of each primer, 1 μ L Taq DNA polymerase, and 1 μ L of the DNA template. Amplifications were achieved in a GeneAmp PCR System 97000 (PE Applied Biosystems, Foster City, California, USA) with the following program parameters: 94°C for 2 minutes, 30 cycles of 94°C for 1 minute, 55°C for 1 minute, 72°C for 2 minutes, and an extension of 72°C for 7 minutes and 4°C for 10 minutes. Amplification products were subjected to electrophoresis on a 1% agarose gel stained with ethidium bromide and visualised under UV light.

The amplicons were purified using a QIAquick PCR purification kit (QIAGEN Inc. Mississauga, Ontario, Canada) and both strands were sequenced using the primers BMBCR, ITS1 (White et al. 1990), ITS2 (White et al. 1990), and ITS4 (for the ITS region) and BMBCR, NS1, NS2, NS3, NS4, NS, NS5, NS6, NS7, and NS8 (White et al. 1990) for the SSU region. The sequencing reactions contained a DNA concentration of 50 nmol mL⁻¹, 0.5 μ L primer, 2.5 μ L sequencing buffer, 1 μ L Big Dye v. 3.0 (Applied Biosystems Inc., Foster City, California, USA), and water up to a total of 10 μ L. Cycle sequencing reactions were achieved using a GeneAmp PCR System 97000 (PE Applied Biosystems) with the following program parameters: 25 cycles of 94°C for 20 seconds, 50°C for 2 minutes, 60°C for 1 minute. Sequencing reactions were run on an AB 3100 Genetic Analyzer (Applied Biosystems Inc., Foster City, California, USA). Sequences were examined using Sequencher 4.0.5 (Gene Codes Corp., Ann Arbor, Michigan, USA). A BLAST search was performed in GenBank to find related sequences.

The SSU sequences were used to place the isolates within the Ascomycota. The ITS sequences were used to place the isolates within the genus to which they were most similar according to a BLAST search (Table 1). Sequences were manually aligned using Se-Al Carbon version 2.0a11 (<http://evolve.zoo.ox.ac.uk>). PAUP (version 4.40b) (Swofford 2003) was used for parsimony analyses of sequences. Gaps were treated as missing. Trees were created using the stepwise addition with bisection-reconnection as the branch swapping algorithm. Branch confidence was tested using bootstrap analysis (Felsenstein 1985) with 100 replicates for the ITS tree and 500 replicates for the SSU tree. *Decorospora gaudefroyi* (= *Pleospora gaudefroyi*) and *Saccharomyces cerevisiae* were used as outgroup taxa for the ITS tree and SSU trees, respectively.

Taxonomy

Monodictys arctica M.J. Day & Currah, sp. nov.

Figs. 1-10

MYCOBANK #: MB510336

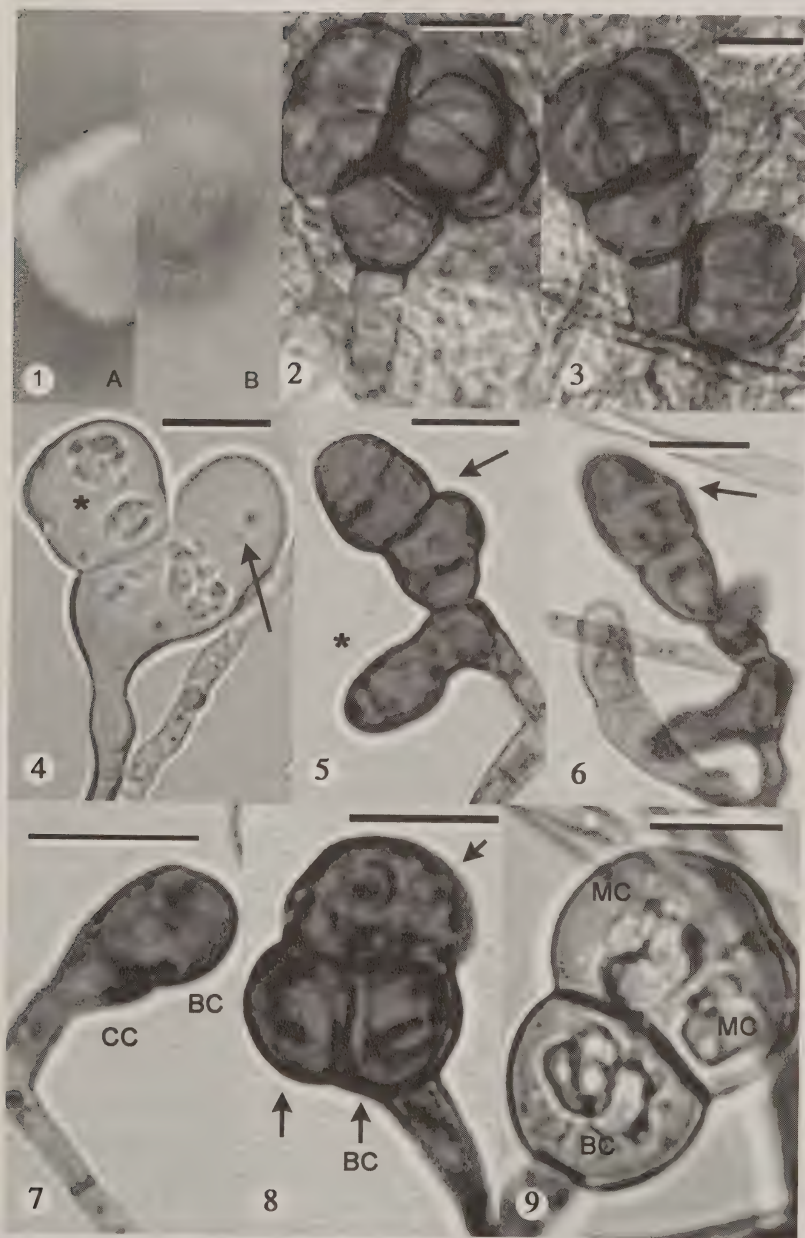
In OAT et PDA, coloniae floccosae, margines leves, interdum discolorationem brunneam medii causantes. In PDA, colonia 35 mm post 35 dies, primum alba ad pallide brunnea, deinde brunnea post 4 dies et argenteo-grisea post 7 dies. Conidia sessilia et lateralia in hyphis vegetativis vel ex extremis ramorum orientia, 5–330 μm longitudine, consistent ex cellulis basalibus blastice productis et ex proliferatione distali cellularum, usque ad 24 numero, quae oriuntur ex incremento meristemato; imperfecte globosa quando maturant, oblonga, ellipsoidea vel pyriformia vel inaequaliter vel dichotome ramosa, interdum latiora quam longiora, maxime nigrata (melanisata), levia, crassiter tunicata, constricta prope septa, 12–80 $\times$ 12–90 μm . Isolata ex radice Saxifragae oppositifoliae ex insula Ellesmere.

Etymology recognises the collecting locality for the host plant.

Colonies on OAT and PDA floccose with even margins, occasionally causing brown discoloration of medium (Fig. 1). Colony 35 mm after 35 days on PDA, white to light tan at first, becoming brown after four days, and silvery grey

Figs. 1-9 Cultural and morphological features of *M. arctica*. **Figure 1.** Colony morphology at 12 days of *Monodictys arctica* isolates on (PDA) and (OA). Brown discoloration of medium shown on OA, a) UAMH 10719 on PDA. b) UAMH 10720 (ex-type strain) on OA. **Figure 2.** Globose conidium from a 14 d culture of UAMH 10719 stained in APVA showing the prominent basal cell (*) attached to the conidiogenous cell. **Figure 3.** Conidium from a 14 d culture of UAMH 10719 stained in APVA showing branches. Conidial breadth is larger than length. **Figure 4.** Conidium from a 9 d slide culture of UAMH 10720 cleared in 10% KOH showing development of a second conidial branch (arrow) before division of the first branch (*). **Figure 5.** Conidium from a 7 d slide culture of M.J.D.727 (from same root as UAMH 10723) stained with APVA showing development of a second conidial branch (*) after division of the first branch (arrow). **Figure 6.** Conidium from a 7 d slide culture of UAMH 10718 stained in APVA showing a newly formed septum (arrow). **Figure 7.** Conidium from a 3 d slide culture of M.J.D.727 (from same root as UAMH 10723) stained in APVA showing a basal cell (BC) protruding from the conidiogenous cell (CC). **Figure 8.** Branched conidium from a 7 d culture of UAMH 10718 stained in APVA showing the meristematic initials (MI) of two branches produced by basal cell (BC). **Figure 9.** Conidium from a 9 d slide culture of UAMH 10722 cleared in 10% KOH after division of meristematic initial (MC = meristematic cell). BC = basal cell.

All bars = 10 μm .



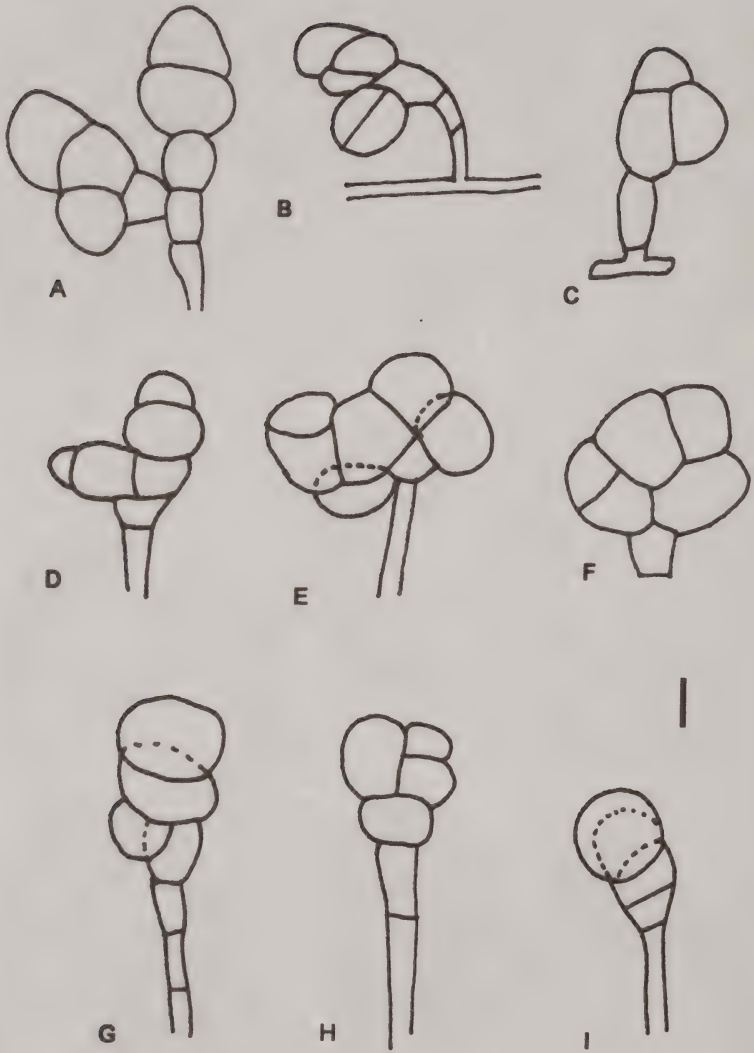


Fig. 10. Line drawings of conidia of *Monodictys arctica*. A. Irregularly shaped branched conidium. B. Branched conidium with second branch just developing. C. Conidium showing two meristematic initials. D. Branched conidium with breadth greater than length. E. Conidium broader than long. F. Roughly globose conidium. G. Roughly ellipsoidal conidium. H. Young, roughly globose conidium. I. Young conidium.

Bar = 10 μ m

after seven days. Conidia sessile and lateral on vegetative hyphae or arising from lateral branches 5–330 µm in length, consisting of a blastically produced basal cell and a distal proliferation of up to 24 cells arising from meristematic growth (Fig. 2); at maturity, roughly globose, oblong, ellipsoidal, or pyriform to irregularly shaped or dichotomously branched (Figs. 3, 4, 5), deeply pigmented and appearing olive to dark brown, smooth, thick walled, with constrictions at septa, 20–80 × 12–50 µm when length greater than breadth and 12–67 × 20–90 µm when breadth greater than length.

HOLOTYPE – CANADA. ELLESMERE ISLAND: Alexandra Fiord, Nunavut (78° 53'N, 75° 55'W), ex roots of *Saxifraga oppositifolia*, 17 Jan 2001, UAMH, a dried culture derived from UAMH 10720 - M.J.D. 121 = K.E.F. 1-S1-OTC3-Saop 3.2)

PARATYPES – dried cultures derived from the following cultures and deposited in the UAMH. All from roots of *Saxifraga oppositifolia* collected at the type locality: 18 Sep 2000, UAMH 10718 - = M.J.D. 73 = K.E.F. 1-S4-OTC3-Saop 4.3; 20 Dec 2000, UAMH 10719 - = M.J.D. 86 = K.E.F. 1-S1-C3-Saop 1.2; 16 Nov 2000, UAMH 10721 - = M.J.D. 192 = K.E.F. 1-S4-OTC2-Saop 4.6; 13 Sep 2000, UAMH 10725 - = M.J.D. 217 = K.E.F. 1-S4-OTC3-Saop 2.2; 25 Sep 2000, UAMH 10722 - = M.J.D. 607 = K.E.F. 1-S4-OTC2-Saop 2.2; 13 Oct 2000, UAMH 10723 - = M.J.D. 729 = K.E.F. 1-S4-OTC2-Saop 1.1B; 13 Oct 2000, UAMH 10724 - = M.J.D. 732 = K.E.F. 1-S4-C1-Saop 4.2.

Results

For both the SSU and ITS regions, isolates shared greatest sequence similarity with *Leptosphaeria* species according to BLAST searches of GenBank. Subsequent parsimony analysis of the SSU DNA placed *M. arctica* in the *Dothideomycetidae* (Fig. 11). The SSU tree included 31 taxa and 1022 characters, of which 740 were constant, 98 parsimony uninformative, and 184 parsimony informative. Nineteen most-parsimonious trees were produced for the SSU region. The consistency index (CI) was 0.612, the retention index (RI) 0.753, and the homoplasy index (HI) 0.388. Analysis of the ITS regions of *M. arctica* and *Leptosphaeria* species placed our isolates in the same clade as *L. dryadophila* (Fig. 12). The ITS tree included 18 taxa and 600 total characters, 336 of which were constant, 85 parsimony uninformative, and 179 parsimony informative. One most-parsimonious tree was produced for the ITS region. The CI was 0.579, the RI 0.490, and the HI 0.421.

Discussion

Our isolates are accommodated within *Monodictys* reasonably well on the basis of morphology even though previous authors have noted that the boundaries among similar genera having pigmented, muriform conidia can be difficult to recognise (Rao and de Hoog 1986, Rodríguez et al. 2001). The genus was erected by Hughes (1958) with *M. putredinis* (Wallr.) S. Hughes as the type species, and is characterised by the production of single, dry, darkly pigmented, multicelled



Fig. 11. One of 19 most parsimonious trees based on an analysis of the small subunit rDNA of *Monodictys arctica* and other ascomycetes. The CI = 0.612, RI = 0.752, and HI = 0.38. The outgroup was *Saccharomyces cerevisiae*. Bootstrap support in percentages (for 500 replicates) is shown on branches where support is greater than 50%. T signifies the ex-type strain.

conidia that arise from monoblastic conidiogenous cells. The absence of sporodochia and conidial chains distinguishes members of this genus from developmentally similar taxa (e.g., *Epicoccum*, *Alternaria* respectively) but the resulting group is heterogeneous and the genus needs re-examination and

revision (Rao and de Hoog 1986, Rodríguez et al. 2001). *Monodictys arctica* is distinguished from others in the genus by having smooth, mostly irregularly shaped conidia that are occasionally branched. The conidia of *M. antiqua* (Corda) S. Hughes and *M. lepraria* (Berk.) M.B. Ellis are somewhat similar in being lobed (Ellis 1976) but are larger, up to $75 \times 25 \mu\text{m}$ in *M. lepraria* and $100 \times 50 \mu\text{m}$ in *M. antiqua*.

During conidium development in *M. arctica*, the conidiogenous cell swells and produces a transverse septum (Fig. 6) that delineates a basal cell (Wang 1990) (Fig. 7), which in turn produces one or two cells that serve as meristematic initials (Fig. 8). Meristematic initials are subsequently partitioned by septa that form on irregular, i.e., non-orthogonal, planes of division, but resultant cells ("meristematic cells," Fig. 9) enlarge so that the component cells of the mature conidium are similar in size. The basal cell persists in the mature conidium and is recognised by being less heavily pigmented than the more distal meristematic portion. This developmental sequence agrees with previous observations made by Hughes (1953) and Ellis (1971) on *M. paradoxa*. By observing longitudinal sections through the conidium, and the subtending conidiophore in *M. paradoxa* (Corda) S. Hughes, using transmission electron microscopy, Wang (1990) determined that conidiogenesis involved percurrent proliferation of the conidiogenous cell, which resulted in the formation of an inconspicuous annellophore. This process was not detected in *M. arctica* using light microscopy. We also did not see evidence of rhexolytic dehiscence or remnants of the conidiogenous cell forming a hilum (Samuels 1980). Further observations using ultrastructural techniques would be useful in clarifying the mode of conidiogenesis in our new species and similar observations across a range of species of *Monodictys* could be of value in clarifying the conceptual limits of the genus.

Analysis of SSU sequences places *M. arctica* within the *Dothideomycetidae*. Only two other species of *Monodictys*, *M. pelagica* (T. Johnson) E.B.G. Jones and *M. castanea* (Wallr.) S. Hughes, are represented by sequences in GenBank and these show affinities with the *Sordariomycetidae*. However, links between the Loculoascomycetes (sensu Barr and Huhndorf 2001) and *Monodictys* have been reported. For example, Samuels (1980) observed conidia resembling *M. putredinis* developing in cultures derived from ascospores of *Ohleria brasiliensis* (*Melanommataceae*). Unfortunately, there are no sequences for either *M. putredinis* or *O. brasiliensis* in GenBank.

Phylogenetic analysis of the ITS region suggests that *M. arctica* is quite likely the anamorph of a species of *Leptosphaeria*, a loculoascomycete genus known from a broad range of plants and habitats, but otherwise having pycnidial anamorphs (e.g., in *Coniothyrium*, *Diplodina*, *Haplosporella*, *Phaeoseptoria*, *Phoma*, *Scolecosporella*, *Septoria*, and *Stagonospora*; Dennis 1981, Farr et al. 1989). Pycnidia were not observed in our cultures but conidial development

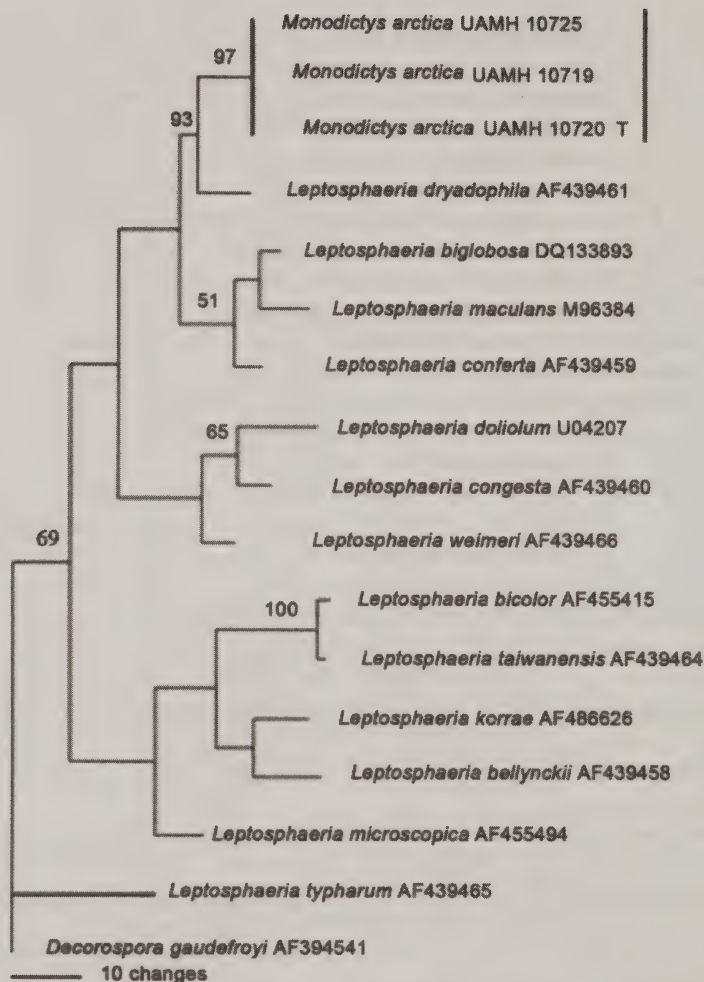


Fig. 12. The most parsimonious tree based on an analysis of the internal transcribed spacer region of *Monodictys arctica* and members of *Leptosphaeria*. The CI = 0.579, RI = 0.490, and HI = 0.721. The outgroup was *Decorospora gaudefroyi*. Bootstrap support (100 replicates) is shown on branches where support is greater than 50%. T signifies the ex-type strain.

in *Monodictys* resembles stages in the development of pycnidia by *Phoma* and *Asteromella*. Also, the *Monodictys*-like anamorph of *Tubeufia amazonensis* (*Tubeufiaceae*) often forms pycnidial locules bearing phialides and single-celled conidia (Samuels 1980). Finally, the formation of pseudoparenchymatous balls,

reminiscent of large dictyoconidia, have been associated with the appearance of pycnidia and ascomata in *Leptosphaeria* (Samuels 1980).

The closest genetic match to *M. arctica* (94% similar to the ex-type strain, UAMH 10720) is *L. dryadophila* Huhndorf (= *Melanomma dryadis* Johanson). The close genetic similarity between these two species and the similar habitat, i.e., on subfrutescent perennial species native to arctic or alpine habitats, suggest these taxa might be sibling species but additional data supporting this supposition are missing. For example, it is unknown if *L. dryadophila*, which produces its ascostromata on the leaves and flowers of *Dryas octopetala* and *D. integrifolia* (Huhndorf 1992, Chlebicki 2002), is systemic and in the roots of these hosts. Furthermore, and as far as we are aware, an anamorph is unknown for *L. dryadophila*. Three other species of *Leptosphaeria*, i.e., *L. brachyasca* Rostr., *L. hyperborea* (Fuckel) Berl. & Voglino, and *L. oreophila* Sacc. (Connors 1967, Farr et al. 1989) have been reported from species of *Saxifraga* but neither cultural nor sequence data are available for these taxa.

Whether *M. arctica* inhabits root cortices in the same relatively harmless manner as other dark septate endophytes such as *Phialocephala fortinii*, *Leptodontidium orchidicola*, and *Scytalidium vaccinii*, all of which were among the isolates examined from the four angiosperm hosts, is unknown. Pattern of occurrence, i.e., in one of four plant species collected from within and outside the OTCs, suggests that host identity had a stronger influence than the experimental treatments. Direct examination of roots of *Saxifraga oppositifolia* infected with *M. arctica* is required to determine the colonisation pattern and whether the fungus is a pathogen or relatively harmless parasite. Furthermore, close inspection of host shoot tissues might indicate the presence of a previously overlooked loculoascomycete teleomorph similar to *Leptosphaeria dryadophila*.

Acknowledgements

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BOOK REVIEWS AND NOTICES

Compiled by

DAVID L. HAWKSWORTH¹

*MycoNova, The Yellow House, Calle Aguila 12, Colonia La Maliciosa
Mataelpino, ES-28492 Madrid, Spain*

General

MykoLibri: Die Bibliothek der Pilzbücher. By Christian Volbracht. 2006. MykoLibri, Isestraße 79, D-20149 Hamburg, Germany (e-mail: mykolibri@aol.com). Pp. 528, col. figs and plates 450. ISBN Not indicated. Price: 140 € (normal edition), 220 € (special edition), 540 € (deluxe edition).

This had to take first place in this set of reviews. Christian Volbracht's journey on the road to becoming a mycobibliophile started with a copy of Werner Rauth's *Unsere Pilze* (Carl Winter Universitätsverlag, Heidelberg, 1951) he found on his grandfather's bookshelf. He started to collect, and then in 1974 met the Hamburg collector Joachim Schleimann who put him in contact with the natural history book dealers Wheldon & Wesley in Tring. Contacts with dealers in Amsterdam and Paris followed, and at an auction of some of Schleimann's rarer works in London in 1982, he also encountered the American collector Robert E. Machol, whose personal mycological library was legendary. Christian's collecting gradually developed into selling and exchanging, and evolved into an antiquarian bookselling business launched on the internet in 1996 – and so much more pleasurable than being a foreign correspondent.

What he has accumulated is truly amazing — to judge from this catalogue of his personal library, which treats over 3000 mycological books, manuscripts, and prints that appeared between 1481 and 1959. But this is no ordinary library catalogue. For each work the fullest bibliographical details have been compiled along with numerous notes, and interspersed with superb reproductions (mostly in colour) of 450 selected plates from them – including 90 that are

¹Books for consideration for coverage in this column should be mailed to the Book Review Editor (address above) in the first instance. Fax (+34) 91 857 3640; e-mail: myconova@terra.es.

full-page. The paper used is Munken Pure, which is both a joy to handle and really does justice to the plates. It includes "all the Great fungal books as well as many considered rare ('rara'), very rare ('rarissima') or nearly impossible to find ('unfindables')" (p. v).

Although the text is in German, an English translation of the introductory sections is available as a tip-in.

Christian's love of mycological books exudes from every page, and this is surely destined to become one of the standard reference sources on mycological works that will be sought after by all mycobibliophiles. The idea of producing such a catalogue was probably inspired by the published catalogues of the personal mycological libraries of Schliemann in Hamburg (Uellner 1976) and Howard A. Kelly in Michigan (Kreiger 1924), but surpasses both those both in content and the splendour of the presentation.

The work comes in three editions: Deluxe (copies 1-25 with more than 20 original coloured plates), Special (copies 26-75 with one original plate), and Normal (copies 76-750). All are individually numbered and signed by the author using "Coprinus ink" prepared using Buillard's recipe of 1792. The price for the normal edition is very reasonable considering its size and quality, and this is a reference work all major mycological libraries should have, and all mycobibliophiles will treasure.

Kreiger, L. C. C. (1924) *Catalogue of the Mycological Library of Howard H. Kelly*. Privately printed, Baltimore.

Uellner, W. (1976) *Fungorum Libri Bibliothecae Joachim Schliemann*. J. Cramer, Vaduz.

Evolutionary Genetics of Fungi. Edited by Jianping Xu. 2005. Horizon Bioscience, 32 Hewitts Lane, Wymondham, Norfolk NR18 0JA, UK (web address: www.horizonbioscience.com). [Distributed by Taylor & Francis, 2 & 4 Park Square, Milton Park, Abingdon, Oxfordshire OX14 4RN, UK.] Pp. viii + 350. ISBN 1 904933 15 7. Price: £ 99.

My initial reaction on seeing this title was, "surely there cannot be room for yet another book on fungal genetics". On looking at the list of contents and contributors, 19 all from North America or China, I realized that this promised to be more the type of introduction I would want to see being available to graduate students in particular, as it contains authoritative in-depth reviews from across the field.

Especially valuable is the first chapter on Molecular Systematics: Major fungal phylogenetic groups and fungal species concepts, by Jean-Marc Moncalvo, which ranges from the concept of the kingdom, the fossil record, molecular phylogentic systems, discussions on all major groups, and species concepts. Although the overall system is currently changing rapidly, this has references into 2004, including the results from the first major Assembling the

Fungal Tree of Life (AFTOL) paper. The second is something of a miss-fit on the Biodiversity and Biogeography of Higher Fungi in China, and while falling into the common problem of not defining the height of the fungi covered, has the purpose of exposing geneticists to broader issues on a regional scale, but sadly hardly mentions lichen fungi except in the abstract. The chapter is also made difficult to read through totally inappropriate additions of author citations after scientific names – fortunately something emulated in only one other chapter.

The next five chapters consider biological concepts of vegetative self- and non-self recognition systems, provide a succinct and valuable review of methods of molecular population genetic analysis, and then contributions on population genetics in “Phycomycetes” (a very dated word for a chapter title which I was shocked to see at all in an otherwise forward-looking work), human and animal pathogens, and basidiomycetes. The basidiomycete chapter only considers macromycetes, and also has much on *Cryptococcus neoformans*, and it would have been good to see something of the elegant work on rusts, *Ophiostoma*, and *Phytophthora*.

The closing four chapters are all special and focus on topics meriting modern reviews: on mitochondrial inheritance and evolution, a scholarly account by the editor and Zhuan Yan; the evolution of drug resistance in human pathogenic fungi by Theodore C. White and colleagues; spontaneous mutations in fungi by Clifford Zeyl; and *Cryptococcus neoformans* as a model for studying signal transduction systems by Ping Wang and Deborah S. Fox.

While the book would have benefited from paying more attention to work on plant pathogens and the fascinating work on endomycorrhizal signalling, and more rigorous editing, it merits wide use in courses on fungal biology and evolution. Sadly, the unreasonably high price will place it beyond the pockets of the tertiary students that would most benefit from it, and further means that the important reviews it contains will not be as frequently cited as it merits. Perhaps the publishers could consider releasing a soft-cover edition . . .

100 Years of Fungal Biodiversity in Southern Africa. Edited by Pedro W. Crous, Michael J. Wingfield, Bernard Slippers, Isabella H. Rong & Robert A. Samson. 2006. Centraalbureau voor Schimmelcultures, P.O. Box 85167, 3508 AD Utrecht, The Netherlands (e-mail: info@cbs.knaw.nl). [Studies in Mycology No. 55.] Pp. 305. ISBN 10: 90 70351 62 5, 13: 978 90 70351 62 5. Price: 65 €.

This volume stems from the centenary celebrations of the National Collection of Fungi (PREM) in Pretoria, South Africa in 2005, which now holds almost 60 000 collections. The collection was initiated in 1905, when South Africa was a British colony, after the Boer War (1899-1902) with Pole Evans (1879-1968). But it was Ethel Mary Doidge (1887-1965), first appointed as Evan's assistant that was the force behind its' growth, and whose monumental synthesis of

what was known on all fungal groups from the region (Doidge 1950) remains a classic and much used work; it treated 4748 species, and is now available online through CBS (www.cbs.knaw.nl/mycoheritage). Isabella Rong and Alice Baxter document the growth with numerous old photographs, and its role in key work on plant pathogens in details. But just how large is the southern African mycobiota? Ten specialists on different groups combine forces to provide an estimate, coming up with a conservative 200 000, excluding those associated with the enormous insect diversity in the region.

Eighteen original papers follow the introductory duo, mainly focussing on molecular phylogenetic studies on plant pathogens, but combining that data with critical morphological investigations. And — as might be expected from the foregoing — many scientific novelties. Appropriately, and in keeping with the model of the CBS centenary volume (*Studies in Mycology* 50(1-2), 2004²), these number 101, including one new family (*Quambalariaceae*), ten new genera, 37 new species, one new form, and 52 new combinations. All these cannot be enumerated here, but can be seen and downloaded as pdf files free of charge from the CBS website. Of most widespread interest are three new segregate genera from *Cryphonectria*, *Mycosphaerella* and other fungi on *Eucalyptus*, the re-instatement of *Ceratocystiopsis*, *Calonectria* species and their *Cylindrocladium* anamorphs, a new generic system for *Botryosphaeriaceae*, and new taxa found on endemic plants. All contributions are well illustrated by line drawings and generally superb micrographs, many in colour.

The mix of history and cutting edge systematic mycology, is a fitting tribute to the centenary, and holds promise of more exciting achievements, not least through the close association PREM enjoys with FABI (Forestry and Agricultural Biotechnology Institute, University of Pretoria).

Doidge, E. M. (1950) The South African fungi and lichens to the end of 1945. *Bothalia* 5: 1-1094.

La Biodiversità dei Funghi del Parco: Inventario della flora micologica del Parco Naturale Migliarino San Rossore Massaciuccoli. By Paolo Franchi, Manuela Giovannetti, Luca Gorreri, Mauro Marchetti & Giovanni Monti. 2006. Felici Editore, Via Carducci 64/C, I-56010 Ghezzano (Pisa), Italy (e-mail: felici@feliceditore.it). [I Libri di Leonardo.] Pp. 360, illustrated. ISBN 88 6019 032 0. Price: 30 €.

The fungi of this 23 114 ha regional park to the west of Pisa have been studied for some two centuries, and this work compiles and presents that data using literature and specimens preserved in museums and other institutions. The park includes extensive coastal dunes, and several woodland types. Bearing in

² Reviewed in *Mycotaxon* 92: 470-471 (2005).

mind that even though lichen-fungi are omitted and only ten anamorphic fungi are listed, the total of 1485 taxa is particularly impressive. Dung fungi and burnt areas have had particular attention, the former due very much to studies by Franceso Doveri, a leading authority on these³. The species entries include full information on collections with dates and the person making the determination, ecological information, and for some rarer species also descriptions. The arrangement follows the current edition of *Ainsworth & Bisby's Dictionary of the Fungi*, and I was pleased to see the system of citing dates of publication after author citations after all accepted names adopted. However, I was unsure why the new generic system for most species formerly referred to *Coprinus* was not adopted or discussed. Two new combinations are made: *Clavulina coralloides* f. *mutans* (syn. *C. mutans*) and f. *subcinerea* (syn. *C. cristata* f. *subcinerea*). Fine colour photographs, some of microscopic characters, make the book a pleasure to look through; some are of frequent species, but many of ones not or rarely figured in field guides (e.g. *Agaricus ossecanus*, *Coprinus cothurnatus*, *Peziza subumbrina*, *Plectania melastoma*, *Ramaria broomei*, *Volvariella murinella*). This is a most carefully executed work, and provides a basis on which to build to approach a full inventory of the fungi of this clearly important mycological site.

Hongos, Líquenes y Briófitos del Parque Nacional de la Caldera de Taburiente. Edited by Esperanza Beltrán Tejera. 2004. Ministerio de Medio Ambiente, Madrid, Spain. Pp. 504. [Organismo Autónomo de Parque Nacionales, Serie Técnica.] ISBN 84 8014 570 6. Price: Not indicated.

This book is the output from a project started in 1998 to inventory the fungi (including lichens) and bryophytes of this 3500 ha national park, which occupies the volcanic crater on the summit of La Palma, one of the Canary Islands. There is also a wealth of background information on the vegetation, with habitat photographs and phytosociological units, geological maps, and climatic data. For each section a similar format is adopted: a review of earlier reports, lists of sites visited (118 for non-lichenized fungi, and 139 for lichenized and lichenicolous ones), methods of study, information on habits, and then the species accounts. The latter include brief descriptive information, ecological notes, comments on world distribution, and indications of which of any of the Canary Islands the species is also known. Colour photographs are included for several species, and distribution maps of each within the park are collected together in the penultimate section. As the species are, thankfully, presented alphabetically, the sections close with a systematic arrangement of the accepted species. Author citations are omitted from the main lists, something I applaud,

³ See the review of Doveri's book in *Mycotaxon* 90: 220-221 (2004).

but they do feature in the systematic arrangements, the reason for which escapes me! The editor is the lead author on the main fungus section, which includes 259 species, mostly slime-moulds and macromycetes, of which 103 are new to La Palma, and 42 new to the Canary Islands as whole. This is clearly hardly more than the tip of the iceberg, but a valuable start and emphasising from the new records that it is an important site for fungal conservation and diversity in the Canary Islands. Consuelo Hernández Padrón is first author on the section on lichens, which is certainly more complete, as it was 264 lichen species, and 26 of lichenicolous fungi: I suspect co-author Javier Etayo Salazar was responsible for the last relatively large figure. There are lists of common names of both plants mentioned and also for the fungi (including lichens), an integrated comprehensive bibliography, and an index listing taxa by binomials and by species epithets. It is hardbound, well laid out, carefully edited, and makes extensive use of colour in charts and diagrams as well as photographs. That this work has been published at such a high standard by the Spanish ministry for the environment is another indication of how highly the ministry regards the biodiversity and conservation of fungi (including lichens).

Biodiversità nel Senese: Flora macromicetia nel XX secolo. By Claudia Perini, Carla Barluzzi, Angela Lagana & Elena Salerna. 2004. Accademia del Fisiocritici Onlus, Piazzetta Silvio Gigli 2, I-53100 Siena, Italy (e-mail: fisiocritici@unisi.it). [Memorie No. 11.] Pp. 335. ISBN: Not indicated. Price: 20 €.

This work brings together records of macrofungi, both larger basidiomycetes and larger ascomycetes, made in the Siena area over the past century. It is based on compilations from the literature and specimens preserved in SIENA and other collections and has been made possible through the help of "amateur" and professional mycologists. The total number of taxa reported is 1314, of which 161 have not previously been published. The list is arranged alphabetically, regardless of group, and for each species references to localities and sources are provided, whether literature or preserved collections. Synonyms are not given in the list itself, but ones used in the area are presented in an Appendix; another Appendix gives fuller locality details with map references and latitude/longitude coordinates for 318 sites listed. This carefully prepared compendium will be of considerable help to all wishing to determine macromycetes in the Siena region or ascertain whether species they have collected are already known from the area.

Checklist of Fungi in Panama: preliminary version. By Meike Piepenbring. 2006. Estafeta Universitaria, Universidad Autónoma de Chiriquí, Código Postal 0427, Provincia de Chiriqui, República de Panamá (e-mail: puentebiol@unachi.ac.pa) [order from Meike Piepenbring, Department of Mycology, Institute 1, Building D, J. W.

Goethe Universität, Siesmayerstraße 71-73, D-60323 Frankfurt/M, Germany (e-mail: piepenbring@em.uni-frankfurt.de).] [Puente Biológico Vol. 1.] Pp. 190, 45 coloured figs. ISSN 1991-2986. Price: 16 €, US\$ 20.

This first checklist for the fungi of Panama, a country which the author has been visiting regularly since 1994, is based on a study of some 300 publications including around 3330 records, accepts approximately 1810 taxa in 646 genera. Listing fewer species than are known from one individual site in the UK, it is not be construed as an inventory of the mycobiota of Panama, but a background for future research in the country. I was pleased to see all “fungal” groups covered, including myxomycetes and lichens, though I was sad to see archaic categories such as “Ascolichenes” and “Basidiolichenes” employed rather than being integrated into the *Ascomycota* and *Basidiomycota* sections, respectively. For each species, information on ecology (including host plants), and/or growth form, provinces from which records came, and literature sources, are included. Species first described from the country are highlighted. This has been a painstaking work to compile from so many sources, and provides a landmark publication for all future mycological recording in Panama. It will certainly stimulate me to try and make time to work-up the collections I made there in 1995!

Basidiomycetes

Checklist dei Funghi Italiani / Checklist of Italian Fungi. Basidiomycetes. Basidiomycota. Co-ordinated by Silvani Onofri. 2005. [Organization for the Phyto-Taxonomic Investigation of the Mediterranean Area. Commission on Fungi. Publication No. 1.] Carlo Delfino Editore, Via Caniga 29/B, I-07100 Sassari, Italy (e-mail: info@carlodelfinoeditore.it). Pp. 380. ISBN 88 7138 387 7. Price: 40 €.

This checklist is the first comprehensive listing of the basidiomycetes of Italy for almost a century. It covers 3889 species in 439 genera, and also includes several hundred infraspecific taxa. For each of the included taxa, the name and author citation are provided, along with recently used synonyms. Citation of sanctioning is not consistent – that by Fries is omitted, but that by Persoon is indicated. Notes are provided for ‘critical’ species, where delimitation is uncertain or problematic against other taxa. The Introduction states that 31 taxa are endemic. A list of these would have been useful; I could only find *Pleurotus nebrodensis* from Sicily indicated as endemic in the text. In addition, 17 exotic taxa are noted, although a few undoubted exotics (such as the *Eucalyptus* associates *Hydnangium carneum* and *Setchelliogaster tenuipes*) are not flagged as such. There is no index but entries are conveniently arranged alphabetically by genus and species. Introductory material in Italian and English explains the scope and production of the work, including the legislative framework for the

accumulation of information on fungal names and distribution. Production of the checklist was supported by the Italian Ministry of the Environment. The *Ustilaginomycetes* and *Urediniomycetes* are to be dealt with in future volumes, along with the *Ascomycota*.

For each entry, the largest component is the information on distribution, which is given for the 20 regions of Italy, from Trentino-Alto Adige to Calabria, as well as Sicilia and Sardegna. For each region in which the fungus occurs, one or more sources are indicated. Sources include published or unpublished lists or herbarium material. Unpublished lists are a mix of those compiled by individuals or groups, and the indication of these takes a little getting used to. It helps to know that "AMB" is Associazione Micologica Bresadola, and that some rather cryptic entries such as "AMB (Gr. Mic. B.Cetto di Mestre-VE), 1999" are in fact references to published articles in the Bibliography, which is comprehensive and contains 893 entries.

Some 295 species are indicated as rare or otherwise at risk. For 96 species details are provided of Italian national and regional laws relating to harvesting and marketing of fungi. It is noted that there are currently no specific regulations concerning the protection of rare and threatened taxa, and that the checklist will provide the basis for creation of a Red List to promote the protection of threatened fungi and their habitats.

The work is very much a joint effort. Eleven mycologists are acknowledged on the title page, and data collation was under the direction of a national co-ordinator, five area co-ordinators, and 17 regional data collectors. The several pages of acknowledgements further attest to the way that the publication draws on numerous groups and more than 170 individuals, particularly for the lists of species from various localities that underpin the detailed information on regional distribution provided for each entry. This collaborative approach is commendable in engaging the wider mycological community, professional and amateur, and in effectively collating a massive amount of data: the regional lists are based on integration of 22 500 discrete records.

Standardisation of nomenclature and taxonomy was also achieved by the participation of a number of contributors, each responsible for particular genera or groups of genera. The source for nomenclature (which also provides the generic placement) is indicated for each entry. The most commonly cited sources are the 1994 *Guide des Champignons de France et d'Europe* of Courtecuisse & Duhem, and the 1999 Dutch checklist (*Overzicht van de Paddestoelen in Nederland*) of Arnolds and collaborators. Nomenclature also draws heavily on the on-line *Index Fungorum* database and the *CBS Aphylophorales Database*. The generic placements adopted are on the whole up-to-date, including such recent changes as the sinking of *Rozites* in *Cortinarius*. Where current revisions are not followed, as in the retention of a wide circumscription for *Collybia*, at least the

alternate names, in this case in *Gymnopus* and *Rhodocollybia*, are referred to in synonymy. Similarly, *Neolentinus lepideus* is retained in *Lentinus*, but the correct genus is given as a synonym. There are, however, some exceptions to adoption of current taxonomy, due to use of source checklists that were published prior to significant revisions of particular groups. Examples are *Coprinus*, *Omphalina* and *Phellinus*, where no reference is made to recent combinations for many species in segregate genera such as *Coprinopsis*, *Arrhenia* and *Fomitiporia* respectively. Use of predominantly European sources for names of exotic fungi means that some correct placements are occasionally overlooked, such as that *Hymenogaster albus* belongs in *Descomyces*. Adoption of *Alnicola* (as frequently used in continental Europe) instead of *Naucoria* (as used by Singer in the *Agaricales in Modern Taxonomy*, and in the 2005 *Checklist of British & Irish Fungi*) highlights a long-running discrepancy, which does need to be sorted out, perhaps by conservation of one or other name. Epithets adopted for species are also, on the whole, up-to-date, as with the use of *Volvariella gloiocephala* for *V. speciosa*; although *Bolbitius vitellinus* is used instead of *B. titubans* (which has the earlier basionym). There are also a few slight discrepancies against other checklists in the spelling of epithets, such as use of *Agaricus campester* and *A. xanthoderma* (more familiar as *campestris* and *xanthodermus*). I noted only one typo, *Lyophyllum* “*eucalyptium*” for “*eucalypticum*”.

This checklist is a valuable addition to the growing number of comprehensive checklists of various regions of Europe, such as the *Checklist of British and Irish Basidiomycota* by Legon & Henrici⁴ and the *Checklist of Polish Larger Basidiomycetes* by Wojewoda⁵ [reviewed *Mycotaxon* 94: 379-80], both published in 2005. Given the high degree of overlap in the taxa included in such checklists, there is great potential for standardisation of names. Standardisation would be particularly useful when integrating other data such as on distribution, ecology, conservation status or molecular sequences. Differences in names adopted, such as mentioned above, are often trivial, but even slight differences in spelling can be a nuisance when attempting integration of data. It would be interesting in the first instance to carry out data matching across the growing number of checklists for basidiomycetes of European countries to determine the degree of mismatch in names, and the source of mismatches (whether nomenclatural or taxonomic). A collaborative approach to clarifying and removing discordant names across Europe would be a worthwhile exercise, and would be a good model for such an exercise on a global scale.

There is no indication that the *Checklist of Italian Fungi* is to be made available electronically, but this would be another useful project, especially if the copious distribution information could be shown as maps, and if particular regions could be queried for lists of the fungi present.

⁴ Reviewed in *Mycotaxon* 96: 336-342 (2006).

⁵ Reviewed in *Mycotaxon* 94: 379-380 (2005).

This work will provide the standard for recording basidiomycete fungi of Italy and will be a great stimulus for expanding distribution information at the regional level. The co-operative approach, using numerous contributors, with the support of a government environment agency, is a model that could well be applied to other regions.

TOM W. MAY

Royal Botanic Gardens Melbourne, Private Bag 2000, South Yarra
Victoria 3141, Australia

Il genere *Cortinarius* in Italia. By G. Consiglio, D. Antonini & M. Antonini. 2003-2005. 3 vols. Associazione Micologica Bresadola, Via Alessandro Volta 46, I-38100 Trento, Italy. ISBN Not indicated. Price: 50 € per vol.

Three volumes of the impressive publication *Il genere Cortinarius in Italia* have now been published by these authors. Although Carls Diego reviewed volume one in an earlier issue of *Mycotaxon*⁶, now that the whole work is available, this review considers all three volumes in more detail.

Each volume consists of a neat solid ring binder with several loose four-page inserts. Volume one and two fit together in one binder. Each volume has an introductory chapter on general aspects of the genus *Cortinarius*. The first volume summarises the infrageneric classification of Moser's *Die Gattung Phlegmacium* (GP), and the two contemporary *Cortinarius* mycobiotas, *Cortinarius Flora Photographica* (CFP) by Brandrud et al. and *Atlas des Cortinaires* (AdC) by Bidaud et al. Furthermore, it contains a chapter on secondary metabolites (colour pigments, toxic substances, etc.) found in or possessed by species of *Cortinarius*. Volume two has a chapter on mycorrhizal associations and population structures. Volume three has a chapter explaining the methodology used to assess the distribution of spore sizes. Furthermore, an infrageneric classification is introduced, and subgeneric separators for organising the species are provided. Several of the introductory chapters are equipped with extensive literature references. Each volume has a table with the classification of each species according to both CFP and AdC, and a growing list of *Cortinarius* literature.

The main body of each volume is 50 species portraits which are spacious and comparable to those presented in other Italian mycological publications (e.g. Sarnari's monograph of *Russula*). Each species is presented on four pages and headed by the species name with full author citations, the place of publication, the type specimen and its location. A list of synonyms is presented, and the systematic placement of the species given according to each of the classification schemes in the works mentioned above (CFP, AdC and GP). The full original

⁶ Reviewed in *Mycotaxon* 89: 512 (2004).

Latin diagnosis is reproduced followed by a translation in Italian, bibliographic references, and the etymology of the name. The description of the species follows the subheadings, *Capello*, *Lamelle*, *Gambo*, *Carne*, *Microscopia*, *Habitat*, and a list of specimens. A taxonomic discussion finishes each presentation. Four illustrations are presented on the facing pages of the spread. On the left page a SEM spore picture is presented as well as a composite illustration with the geographic distribution of the species in Italy (volumes one and two) and six spores representing the extremes according to the methodology introduced in volume three. On the right page, two colour photographs of the species in its natural habitat are presented.

At first glance the publication has the appearance of a cornerstone in cortinariology. Although, the publication contains a lot of valuable information, I find at the same time that it presents several problems.

Introductory chapters

The idea of presenting several aspects of the biology of these interesting fungi is good, as taxonomists all too often work in a “classification vacuum”, ignorant of ecological information, etc., and *vice versa*. The chapters on chemistry, ecology and spore statistics are very detailed and interesting reviews for the inclined. The essence of these chapters could have been boiled down to allow for other more urgent things to be presented (e.g. methodology, species concepts, morphological characters). An interesting addition to the chapter on the competing classification schemes in *Cortinarius* would have been a more analytical comparison instead of a simple list of infrageneric taxa. Volume three introduces a subgeneric classification and discusses this in light of recent molecular phylogenetic findings. Somewhat pragmatically, the authors settle on a taxonomy with seven subgenera, *Cortinarius*, *Myxacium*, *Phlegmacium*, *Rozites*, *Dermocybe*, *Telamonina* and *Leproclybe*, of which only two are potentially monophyletic. The choice of not introducing a completely new infrageneric taxonomy is wise as our present phylogenetic (and morphological) knowledge of the whole genus is still very scarce. The concept is not far from either of those applied in CFP and AdC and the groups are thus not too unfamiliar for most cortinariologists.

The chapter in volume three on the statistical treatment of spore measurements is very interesting. Most taxonomists treat spore length and breadth as independent of each other, and calculate mean value and standard deviation for each separately, which is intuitively wrong. Thus, the authors assume that the length and breadth of spores co-vary, which gives perfect meaning. The presented and applied statistical methodology results in an “ellipse of isoprobability” which encompass 68 % of the actual observed spores, minimum and maximum measurements of length, breadth, and spore quotient (length/breadth). An Excel sheet with the relevant operations is available from

the authors. Others have employed a comparable but less rigorous methodology simply by drawing an ellipse on a spore scatter diagram. Despite the inherent lack of repeatability and statistical rigour of this last free-hand method, it might be more explicit in identifying (and excluding) obvious aberrant spores, which would otherwise be included in the calculations.

The huge bibliographic lists are useful as it is often impossible to get an overview of relevant literature for this big genus. Many obscure publications have found their way into the list, which, however, still lack many publications to be exhaustive. I can only complement the effort to try to collect all these references in one publication.

Species portraits: Text

In general I find the species presentations pleasant, and with the sheer amount of paper used for each species the layout escapes the appearance of being too crowded. I like the full author citations with publication year. A small inconsistency is that some of them lack the year of publication. As the nomenclature of *Cortinarius* is full of inconsistencies and ambiguities, the full citation is preferable for accuracy. The citation of types is likewise a nice inclusion. Whether the authors actually have studied the types is unclear. To me it seems that the location of types is simply copied from the protologue, so it is, for example, up to the reader to find out where the types of Robert Henry and Marcel Bon are now (they are in Paris and Lille, respectively). Several Henrian types, which are lost, are cited as if they were available for study.

The list of synonyms is often very short, something that partly may reflect the relatively narrow species concept adopted in the major part. But even some "obligate" synonyms have been omitted, e.g. *C. cupreorufus* under *C. orichalceus*. Synonym lists in taxonomic treatments of *Cortinarius* are often flowing over with "*sensu*"-names, which can be relevant but are often very space consuming. This practise is not carried out except in a few instances (e.g. under *C. catharinae*, *C. colymbadinus*, *C. eucaerulescens*). The reason for including/excluding this information in each case remains somewhat obscure.

The indication of the systematic placement of the species in CFP, AdC and GP can be valuable for quick reference purposes, but seems somewhat superfluous as the information is given collectively for all species in tabular form in the introduction. In the portraits, the placement is given with all the infrageneric taxa (and their synonyms) and with full author citations. In several instances this may take up a third of a page -- I find this somewhat redundant and visually disturbing. Several of the presented species have been treated in CFP, AdC and/or GP, and some of the subgeneric placements must thus be at the authors' own expense. For example, *C. caroviolaceus* (portrayed as *C. rapaceus*), a species with morphological and phylogenetic affinities to species

in sections *Calochroi* and *Fulvi*, would not be placed in section *Caerulescentes* by Brandrud et al., and *C. vitellinopes*, *C. cephalixus* and *C. subcephalixus* would not be placed in section *Phlegmacium* (rather than *Elastici*). Several species are indicated to be placed in section *Laeticolores* in CFP – a section that CFP does not use.

The citation of the full original diagnosis can be of value for taxonomically inclined readers as these are often difficult to access. I assume that most native Italians are fully capable of understanding the Latin diagnoses, and the usefulness of the word-to-word translation in Italian is unknown to me.

The species descriptions are relatively brief and include general aspects as well as diagnostic characters, and in most cases they characterize the species adequately, and are comparable to those in CFP and AdC. Macrochemical colour reactions are left out except for reactions with alkaline substances in the context and on the pileus. Some cortinariologists will miss the reactions with, for example, Lugol's solution and guaiac.

The taxonomic discussion concluding each species portrait is the most important paragraph for the active user of a publication like this. In many cases the text is clear and informative, and delimitations from similar accepted taxa are clear. But in many instances I find the choice and number of "similar" species insufficient, as in the following examples: the discussion under *C. elegantior* states the delimitation towards *C. quercilicis*, whereas the discussion of the species portrayed as *C. eufulmineus* (which in my opinion is *C. quercilicis* -- also sensu CFP and AdC) carries no reference to *C. quercilicis*. The three portraits, *C. cephalixus* var. *subopimatus*, *C. subcephalixus* and *C. vitellinopes* are similar, and neither of the taxonomic discussions carry references to the two other. In a few discussions the characters mentioned are in clear contradiction with the illustrations and/or descriptions, for example *C. cedretorum* is (like in most other treatments of this taxon) stated to have a more thoroughly blue colouration in the context than *C. elegantissimus* -- a fact contradicted by the chosen illustrations of the two species.

Species portraits: Illustrations

First I have to complement the colour photographs. Two representative photos of each species (of which several are rarely illustrated) is an important contribution to the documentation of the genus. Most show a sufficient number of fruit bodies and the important characters, and in most cases the pictures complement each other well. The reproduction of colours is generally very good. All photographs are taken with direct flashlight, which makes the exposures more uniform and thus the pictures easier to compare. It also gives some annoying reflections from moist and/or glutinous surfaces (pilei, stipes, leaves, etc.), and in most cases some hard shadows. As the publication is meant as a *Cortinarius* mycobiota of Italy, I find it a shame that the distribution maps have

been left out in volume three. Scanning electron microscopy (SEM) pictures of so many species is again an important contribution to the documentation of the genus. Although the SEM pictures are of variable quality, most of them are good. The spore drawings present six spores. These are not actual spores but represent the extremes as calculated by the method mentioned above. In practice, only one spore has been drawn and subsequently manipulated to fit the extremes. Thus, no variation in the ornamentation and relative proportions is shown. The method is probably just as illustrative as the selection of six representative spores. In volume three, the ornamentation of the six spores has been abandoned. Instead six plain spores illustrating the extremes are shown complemented by two ornamented spores of median size, one seen in lateral view, the other in ventral view showing the suprahilar plaque. In all illustrations the suprahilar plaque appears completely smooth, which is unsupported by the SEM pictures. The reproduction of spore-ornamentation in drawings is a precarious matter. The ornamentation is often represented more minute and/or detailed than the light microscope allows (and often more than the SEM pictures indicate). In a few cases clear contradictions between drawings and SEM micrographs is seen, especially when comparing several taxa (e.g. compare the SEM pictures and spore drawings of *C. vitellinopes*, *C. subcephalixus* and *C. cephalixus* var. *subopimatus*).

Taxonomy

The infrageneric concept applied corresponds more or less to that used during the last century, and is as such familiar to most users.

The delimitation of *Cortinarius* species is a difficult matter. The extent of phenotypic variation has been little tested (e.g. with mating studies, molecular phylogenetics). Thus, species have been delimited based on a subjective evaluation of morphological characters. CFP and AdC probably represent the two extremes of species concepts, i.e. a broad *versus* a narrow concept. The application of names is also difficult, and as many, especially older, names often are difficult to interpret, it is at many times a matter of taste. The choice of species concepts and names lies between CFP and (closest to) AdC. Generally it seems that the authors simply choose between the names applied in CFP or AdC.

Personally, I disagree with the naming and/or circumscription of some of the taxa within the groups I am familiar with (i.e. *Phlegmacium* s. lat.). From the pictures and the descriptions alone I have several comments, and furthermore I have had the pleasure of studying several of the portrayed collections. Below is a brief discussion of my major points of disagreement.

The upper picture of *C. boudieri* is *C. terpsichores*. The lower picture of *C. catharinae* is *C. platypus*. Both pictures of *C. eufulmineus* (which is most likely a synonym of *C. alcalinophilus*) are *C. quercilicis* (also *sensu* AdC/CFP). The

lower picture of *C. frondosophilus* is *C. ochraceopallescens*, and the upper is uncertain (and perhaps *C. haasii*). The species depicted as *C. glaucopus* (which in my opinion is a coniferous forest taxon) is most likely *C. magicus*. The lower picture of *C. molochinus* (a synonym of *C. nymphicolor* in my opinion) is *C. parasuaveolens*, whereas the upper probably is *C. suaveolens*. *C. aurilicis* (which is an independent species) is depicted as a variety (var. *bulbopodius*) of *C. nanciensis* contrasting with the otherwise narrow species concept applied. A putative variety of *C. odoratus* (var. *suavissimus*) is depicted, which in all respects corresponds to the type variety. If *C. olivascentium* is accepted as the right name for the species portrayed as such, *C. xanthochlorus* should have been included as a synonym. The species depicted as *C. rapaceus* (which I perceive as a *nomen dubium* that has been applied to several species) is *C. caroviolaceus*. The species portrayed as *C. subfulgens* (i.e. *C. olearioides*) is most likely *C. claroflavus* (or another species containing phlegmacin pigments). *C. russeoides* is a junior synonym of *C. mussivus* in my opinion. At least the upper picture of *C. velicopia* is *C. barrentium* (a species that may have an older name). The lower picture of *C. violaceipes* is *C. haasii*, whereas the upper is uncertain (perhaps *C. lilacinovelatus* or *C. platypus*). The species portrayed as *C. viridicaeruleus* is *C. subhygrophanus*.

Several taxonomic novelties are presented in the publication. I take the opportunity to comment on some of these within subgenus *Phlegmacium*. *C. turbinatioides* is described as a new species having a more or less brownish cap and pale lamellae and is thus placed in section *Claricolores* (i.e. *Multiformes*). I have had the pleasure of examining the type, and molecular data (unpubl.) give a 100 % ITS sequence match with *C. flavovirens*. And as the illustrations do not plead against conspecificity, I suggest the name *C. turbinatioides* be treated as a junior synonym of *C. flavovirens*. *C. appennini* is described as a new species in section *Glaucopodes*. I find that the species in all respects correspond to the description of Moser's *Phlegmacium avellanocaeruleum*. The authors also state this taxon is the most closely related, and mention some points of dissimilarity, but it is uncertain whether the authors actually accept the existence of two separate taxa. *C. subcephalixus* is described as a new species in the *C. cephalixus*/*C. olidus* group. The description and discussion, however, leave the delimitation from similar taxa somewhat uncertain as indicated above.

Unfortunately, I don't feel capable of commenting in detail on the taxonomy of other groups (i.e. *Telamonia*, *Leprocyebe*, *Dermocybe*, and *Myxacium*).

Methodology

I miss clearly stated methodologies. The only explicitly stated method is that of spore measurement in volume three. In the descriptions the number of spores and collections is mentioned. Following is a discussion of some of the

most important things I find missing. Which collection does the SEM picture relate to? In cases of taxonomic uncertainty this information is obligatory for future use. And, importantly, how were the spores measured? Were they taken from deposits or lamellae? Were they measured in H_2O , KOH, or something else? Were only mature and normally developed spores measured? The table on page 34 of volume three with 100 spore measurements indicates that the authors are able to measure with a precision of one tenth of a micron – what method allowed for this? When this information is lacking, the measurements will be impossible to compare to one's own. Judging from the measurements that are generally more variable and larger than mine, it seems that spores were taken from the lamellae. When working with a group of fungi that allows for measurement of only mature spores (i.e. deposits on the cortina), it is not necessary to work with potentially atypical/immature spores. When the rest of the methods are obscure, the rigid statistical method employed becomes irrelevant in my opinion.

Conclusions

The publication is not expensive compared to other mycological publications, and despite my reservations, it presents a lot of data that has never been gathered in one place before. *Cortinarius* is a difficult genus, and the publication is an important contribution to the knowledge of the genus in Italy, where the group has received little attention in recent times. The publication presents some interesting chapters on ecology, etc., and fine portraits of rarely illustrated species (e.g. *C. moenne-loccozii*, *C. subhygrophanus* (as *C. viridicaeruleus*), *C. subalbescens*, *C. natalis*).

TOBIAS G. FRØSLEV

Department of Microbiology, Institute of Biology
Øster Farimagsgade 2D, DK-1353 Copenhagen K, Denmark

Los políporos (Basidiomycetes) de los Bosques Andino Patagónicos de Argentina. By Mario Rajchenberg. 2006. J. Cramer in Gebrüder Borntraeger, D-14129 Berlin, Stuttgart, Germany. [Bibliotheca Mycologica No. 201.] Pp. 300, figs 68. ISBN 3 443 59103 5. Price: 84 €.

How can the polypores contribute to our understanding of fungal biodiversity? Even though historically regarded as among the most known and worked groups in the *Fungi* (due the obvious macroscopic characters), they are amongst the least studied forest organisms from ecological/physiological approaches. Reminding us that new poroid species still have to be described, the picture presented here suggests this is a fertile field for exploration in the future.

Mario Rajchenberg has worked intensively since 1991 on Andean Patagonian forests, compiling published data from other researchers, and combining that

with his own, in this book on polypores. These forests grow in a very special area in terms of climate, altitude, and humidity, and so sustain a particular mycobiota. So special is the area, that Rajchenberg's name is linked to the majority of included taxa, amongst them, nine species new to science, and thirteen new combinations. He also found 35 % of the species were endemic to the area, and many others are rare elsewhere.

The book is bilingual (Spanish and English), ensuring it will be understandable to most readers in the world. We can informally split the book into two parts. The first, as in other books devoted to poroid fungi, deals with essential general issues; however, the author adds new data so avoiding redundancy. Keys based on macroscopical and/or microscopical characters and species descriptions appear in the second part. The latter include, in most cases, cultural data, which are not very common in books on polypores, and are meticulously discussed. Species illustrations comprise line drawings, which are excellent and elucidative, actually representing morphological characters. Some printed photographs do not catch the whole beauty of the specimens, so the author does not include any, but has posted these on <http://www.ciefap/areas/proteccion/poliporos> where they are easily accessed.

Rajchenberg's book is well written, and provides a new brief on the taxonomy of South American polypores. Analyzed data are clearly presented, critically discussed, and decisions competently made. But, nevertheless, does he stimulate the reader in each discussion, and invite his or her participation? Yes, he provides a state-of-the-art view of the taxonomy-phylogeny debate in polypores, in a direct, credible, and stimulating way that connects with readers' minds.

Finally, we enjoyed the book, and, as researchers on South American polypores, have analyzed it here from the point of view of those who are really going to use it; surely we recommend it for mycological studies in the region.

GILBERTO COELHO¹ AND ROSA TRINIDAD GUERRERO²

¹ Rua Ana Nery 284, CEP 97020030, Bairro Patronato, RS, Brasil

² Instituto de Biociências, UFRGS, Av. Bento Gonçalves 9500, CEP 91501970
Porto Alegre, Rio Grande do Sul, Brasil.

Macrohongos de la Región del Medio Caquetá, Colombia. By Ana E. Franco-Molano, Aída M. Vasco-Palacios, Carlos A. López-Quintero & Teun Boekhout. 2005. Grupo Taxonomía y Ecología de Hongos, Universidad de Antioquia, Colombia (e-mail: afranco@quimbaya.udea.edu.co). [Guía de Campo.] Pp. 218. ISBN 958 655 910 6. Price: 30 000 Cp, US \$ 15.

This is a field guide, published under the auspices of the Grupo de Taxonomía y Ecología de Hongos Universidad de Antioquia, pocket-book size (19 x 11 cm), and written in Spanish. After the acknowledgements, preface, and

guiding suggestions, the book comprises the following chapters: Introduction, Description of species, Glossary, Bibliography, List of herbarium collections used for this book, Index, Synonyms, and finally a fantastic tale on the origin of fungi related by a Colombian Indian.

Scientific and common names, Macromorphology, Spore features, Habitat, Distribution, and popular uses (where they exist), are given for each taxon. The taxa are grouped into orders, and within each of the families treated, showing the most representative taxa in Colombia.

A field illustration is included, together with appropriate symbols to indicate, for example, substrate, habitat, toxicity, and edibility. However, I always doubt the difference between "toxic" and "poisonous". Despite the small size of the illustrations, 7 x 4 cm, their quality is good enough in most cases, but too dark in quite a few.

Ninety-six species are included in this little book. Amongst the most interesting, according to their rarity, are *Hygroaster cleefii*, which is only known in Colombia, and *Cordyceps chlamydosporia* and *Camillea leprieurii* which are both very rare species. Sadly some illustrations are almost useless due to their poor quality: Fig. 28, *Xerula* sp., *Gymnopilus lepidotus*, *Gloeocantharellus uitotanus* (just published as new), *Lentinus concavus*, *Polyporus guianensis*, *P. leprieurii*, *P. virgatus*, *Phellinus calcitratus*, *Coriolopsis polyzona*, *Earliella scabrosa*, *Hexagonia hydroides*, *Kretzschmaria clavus*, *Thamnomycetes chordalis*, *Auricularia fuscosuccinea*, *A. mesenterica*, and *Tremella mesenterica*.

This represents a good contribution to our knowledge of the Colombian mycobiota, which needs an enormous effort to try to understand the immense mycological treasures to be discovered in such a great territory. This first step is something good to begin with.

FRANCISO D. CALONGE

Real Jardín Botánico de Madrid, Plaza de Murillo 2
Madrid 28024, Spain

Common mushrooms of the Talamanca Mountains, Costa Rica. By Roy E. Halling & Gregory M. Mueller. 2005. The New York Botanical Garden Press, 200th St. & Kazimiroff Blvd., Bronx, New York 10458-5126 USA (e-mail: nybgpress@nybg.org). Pp. 195. ISBN: 0-89327, ISSN: 007-8931. Price: \$19.95.

Since receiving this book for review an embarrassingly long time ago, it has remained next to my computer, open to page 131 to remind me of a particularly pleasant June and July in 2000 among the great tall trees of San Gerardo de Dota seeking (and finding) the usually elusive *Phaeocollybia*. Too many of us who benefited from Halling & Mueller's generosity have yet to publish our discoveries from our neotropical field expeditions through the great Central

American oak forests that hug the ridges of the Costa Rican Talamancas from San José south to the Panama border. Fortunately, the authors did not wait for their guests to complete lab work and manuscripts, publishing this fine field guide of the 'common' mushrooms encountered during ten years worth of treks through Costa Rica. While the volume does not pretend to cover all mushrooms of the area, I was surprised to see how many little known or recently named species are included. (The phaeocollybias are particularly fine!)

The volume is both field guide and taxonomic reference. Its 6 × 9 inch size is small enough to be tucked into a camera pack for easy transport but large enough to present enough information and photos on one page for ready identification in both field and at the scope. An external spine displaying the title permits easy location on a library shelf while an internal spiral binding keeps pages open on the lab bench. A waterproofed outer surface ensures that the orange colors of the cover leccinums will remain bright even after the wettest rainy season.

The introduction that summarizes the biology and geological history of the 'Cordillera de Talamanca' includes maps and graphs. Two lists indicate species representing tropical montane *Quercus*-dominated forest endemics or forming ectomycorrhizas with neotropical *Quercus*. Seven pages set forth protocols for collecting mushrooms for scientific study that will benefit both first-time mushroom collector and seasoned mycologist. A key to the ten included 'fleshy basidiomycete' families (*Cantharellaceae*, *Russulaceae*, *Boletaceae*, *Hygrophoraceae*, *Amanitaceae*, *Lepiotaceae*, *Entolomataceae*, *Tricholomataceae*, *Strophariaceae*, *Cortinariaceae*) precedes the main portion of the book, the species descriptions.

The approximately 100 species are presented alphabetically according to (and within each) family. A key to species precedes each family section of species descriptions. Each 1-2-page species treatment provides at least one excellent technical photo accompanied by a full morphological description and notes on substrates, mycorrhizal hosts, distribution, and general comments — this last generally the first paragraph read by the key user. Microscopic data are provided not only for spores and clamp connections, but also for tramal tissues, cystidia, and pileipellis features. Particularly useful micrographs and SEM scans of basidiospores or cystidia (not usually provided in field guides) may also be included. Excellent habitat photos are scattered throughout the descriptions to remind the reader that these organisms do not grow on a lab bench.

There follow a reference section, a list of specimen vouchers, a glossary (both to aid field collectors not acquainted with technical terms and to refresh the memories of those needing memory jogs for atomate, ixotrichodermium, and pseudoparenchymatous but ashamed to admit it), and index to scientific names. The volume closes with brief backgrounds and photos of the authors in

situ that invoke — at least in this reviewer — a heartfelt desire to return to the Costa Rican collecting grounds and such amiable company. Anyone wishing to collect in Central America or who is interested in biogeography of fungi in the ‘new world’ would be well advised to own this book.

LORELEI L. NORVELL

*Pacific Northwest Mycology Service, 6720 NW Skyline
Portland, Oregon 97229, USA*

Ascomycetes

Genera of Freshwater Fungi. By Lei Cai, Kevin D. Hyde & Clement K. M. Tsui. 2006. Fungal Diversity Press, Centre for Research in Fungal Diversity, Department of Ecology & Biodiversity, University of Hong Kong, Pokfulam Road, Hong Kong SAR, PR China (e-mail: kdhyde@hkucc.hku,hk). [Fungal Diversity Research Series No. 18.] Pp. viii + 261, plates 100. ISBN 988 99320 08. Price: US\$ 80.

The title of this well-illustrated book is somewhat unfortunate. As stated in the Preface, it “brings together the literature on freshwater ascomycetes and their anamorphs” (p. iii). Consequently, it does not cover basidiomycete, chytrid, ingoldian, lichen-forming, or straminipilous genera, nor any that may be isolated into culture from freshwater but do not normally sporulate within it.

After a brief introduction to methods used to study freshwater ascomycetes, there are two long keys. The first is to ascomycetous genera known from freshwater habitats “in which taxa have been developed to species level” (p. 5); i.e. genera reported but not identified to species are omitted unless commonly encountered. Some 167 genera are keyed out, with the species reported from freshwater added in brackets – a very helpful feature. However, although it is not stated, the key is essentially identical to that already published by Cai et al. (2003) which has one dichotomy more; the couplet dealing with *Cudoniella* in the 2003 key (no. 146) was deleted in the 2006 one. The second key is “to common genera of aero-aquatic and submerged aquatic hyphomycetes”, is identical to that published by Goh & Tsui (2003), although that is not acknowledged and nor is this reference included in the Literature list. This keys out 88 genera, amongst which ingoldian taxa are surprisingly not to be found; the explanation may rest in that the word “dematiaceous” in the title of the 2003 key does not appear in the heading of the 2006 one. In this key the names of species reported are not indicated as they are in that to the teleomorphs. Both keys are strictly dichotomous and the separations clear, although in the absence of a glossary, users lacking a thorough mycological training will need a copy of *Ainsworth & Bisby's Dictionary of the Fungi* to hand. In long keys I always find it useful to have the numbers of the previous couplets indicated to facilitate back-tracking, and that would certainly been of value here.

The major part of the book is devoted to descriptions and photographic plates. Each of the 100 genera selected for treatment here has a page of text with a plate opposite it. The page starts with the generic name and its author citation (but not the date or place of publication), has an indication of the systematic placement below the generic name, a description, a statement as to the type species, indicates any anamorph reported and the habitat, has often detailed and informative observations under "Notes", and references to pertinent literature. The photographic plates are composites which include habit shots in most cases as well as details of the asci, interascal filaments, conidiogenesis, and spores. The quality of the originals for the plates must have been exceptional, but the standard of reproduction does not do all of them justice. Where possible it is the type species of the genus that is illustrated, but when that was not available an alternate is shown. Making a decision on what genera to include in this part of the book cannot have been easy, but almost all those selected are perithecioid ascomycetes, their anamorphs, and probably allied dematiaceous fungi with no known teleomorphs. No apothecioid species made it (although these are well-covered in the key) and the moniliaceous conidial fungi fared almost as badly (with only *Dactylaria* and *Helicomyces*).

The literature cited is impressive, and occupies 18 pages, but is not without its slips; for example, Cai et al. (2003) is said to be in *Fungi in Marine Environments* (Hyde 2002) – fortunately the reference to the Fungal Diversity Research Series has the correct volume number (though the last page number is "324" not "326"). The index does not include references to genera covered in the key to anamorphs, although generic and specific names in the teleomorph key are indexed. It was evidently also intended (see p. 31) that the index should have the authorities of species names included there as they are omitted in the text, but they are not to be found.

As the keys have appeared before, the main new benefits of this book are the descriptions, notes, and especially the photographic illustrations of the selected genera. There is no doubt that this book will be of immense value to those wishing to identify freshwater perithecioid ascomycetes and allied dematiaceous fungi, and perhaps this can now be built on by the authors to eventually provide a work covering all the genera reported – and with keys to all the species.

- Cai, L. Zhang, K.-Q. & Hyde, K. D. (2003) Freshwater ascomycetes. In: *Freshwater Mycology* (C. K. M. Tseu & K.D. Hyde, eds): 275-324. [Fungal Diversity Research Series No. 10.] Fungal Diversity Press, Hong Kong.
- Goh, T. K. & Tsui, C. K. M. (2003) Key to common dematiaceous hyphomycetes from freshwater. In: *Freshwater Mycology* (C. K. M. Tsui & K.D. Hyde, eds): 325-343. [Fungal Diversity Research Series No. 10.] Fungal Diversity Press, Hong Kong.
- Hyde, K. D. (ed.) (2002) *Fungi in Marine Environments*. [Fungal Diversity Research Series No. 7.] Fungal Diversity Press, Hong Kong.

Hypocreales of the Southeastern United States: an identification guide. By Gary J. Samuels, Amy Y. Rossman, Priscila Chaverri, Barrie E. Overton & Kadri Põldmaa. 2006. Centraalbureau voor Schimmelcultures, P.O. Box 85167, 3508 AD Utrecht, The Netherlands (e-mail: info@cbs.knaw.nl). [CBS Biodiversity Series No. 4.] Pp. ix + 145, coloured plates. ISBN 10: 90 70351 59 5, 13: 978 90 70351 59 5. Price: 70 €.

This identification guide was developed for a workshop on hypocrealean fungi in the Great Smoky Mountains in 2004. It includes members of the order occurring in Georgia, North and South Carolina, and Tennessee. Following an introduction to the group and its characters, with practical hints on, for example how to carry out a KOH reaction test on the perithecia, are a series of dichotomous and synoptic keys. The separations all seem clear, but I do worry when dichotomous keys use substrata as the only characters in a couplet. For each genus there is short description and list of key literature, and then each species has a page devoted to it which has the accepted name, any anamorph, information on habitat and distribution, a detailed description including features of the anamorph as well as the teleomorph, and notes about the ecology, identification or taxonomic placement. But I do wish the genera had been treated in alphabetical not a systematic order as this means always having to go to the index or contents page to find a particular genus. Author citations are provided, but without details of the place of publication; I would have liked to have seen at least the date added after the authors' names. But what makes this work so special is a superb composite full-colour plate for each species, including habit shots and microscopic details of both anamorph and teleomorph. I was also pleased to see the details of the voucher specimens for the illustrations listed in an Appendix. In total, 102 species dispersed through 20 genera are treated. The most speciose genera covered are *Hypocrea* (31 spp.) and *Hypomyces* (23 spp.) so the work will be of particular value in making identifications in those two genera. In two cases the species remain unnamed (*Arachnocrea* sp., *Cosmospora* sp.), in one the identification it is tentative (*Hypocrea* cf. *pseudostraminea*), and a single new combination is made: *Neonectria ditissima* (syn. *Nectria ditissima*) comb. nov. The book is spiral bound so it lies open flat at any page which is ideal for comparing an "unknown" in the microscope with the illustrations. In addition to producing a fine manual, the beauty of the photographs might also encourage more amateur and professional mycologists to study these super fungi.

Taxonomy and Pathology of *Togninia* (Diaporthales) and its *Phaeoacremonium* anamorphs. By Lizel Mostert, Johannes Z. Groenewald, Richard C. Summerbell, Walter Gams & Pedro W. Crous. 2006. Centraalbureau voor Schimmelcultures, P.O.

Box 85167, 3508 AD Utrecht, The Netherlands (e-mail: info@cbs.knaw.nl). [Studies in Mycology No. 54.] Pp. viii + 115. ISBN 10: 90 70351 61 7, 13: 978 90 70351 61 8. Price: 55 €.

When I first was involved with fungi that later became named as *Phaeoacremonium* in the mid-1970s, while we used the name for a human pathogen for a species pathogenic on trees (Hawksworth et al. 1976), the number of species and problems they caused that have subsequently been recognized was not foreseen, not least the importance esca disease of grapevines would assume. Neither was the fact that these fungi are anamorphs of *Togninia* suspected, confirmed only in 2003 by molecular phylogenetic methods. While more and more species have been recognized from humans and woody plants, there has been no overall monograph produced. That is remedied here, in a work combining molecular, cultural, morphological, and nomenclatural investigations.

The full introduction incorporates sections on diseases and disease management in humans and plants, mating studies, molecular investigations, and cultural parameters. A suite of keys includes ones to genera similar to the teleomorph and anamorph, as well as to treated species; these keys are supplemented by tables comparing cultural and micromorphological features, and there is also an online identification database (www.cbs.knaw.nl/phaeoacremonium.htm).

Ten species of *Togninia* are accepted, six described for the first time, and all but one of which have a *Phaeoacremonium* anamorph; three of the latter are unfortunately given new scientific names, contrary to Rec. 59A.3 of the *Code*, but at least the same epithets are employed (and *vice versa* for newly coined teleomorph names). Twelve species of *Phaeoacremonium* in which no teleomorphs have yet been found are recognized, of which three are newly described. The identities of other fungi referred to *Togninia* are treated as a result of examination of type material: five were found to belong in *Calosphaeria* and one in *Jattaea*. Somewhat unexpected, but most welcome, is a synopsis of the 11 accepted genera of *Calosphaeriales*.

The whole work is beautifully illustrated in colour, and the micrographs are particularly superb. It is sure to be the key work on these important fungi for both medical mycologists and tree pathologists for many years to come.

Hawksworth, D. L., Gibson, I. A. S. & Gams, W. (1976) *Phialophora parasitica* associated with disease conditions in various trees. Transactions of the British Mycological Society 66: 427-431.

Lichen-forming fungi

Parmelioid Lichens in India (a revisionary study). By Pradeep K. Divakar & Dalip K. Upreti. 2005. Bishen Singh Mahendra Pal Singh, 23A new Connaught Place, Dehra Dun, 248001 India (e-mail: bsmps@vsnl.com). Pp. xii + 488, coloured plates 58, maps 194, tables 3. ISBN 81 211 0389 4. Price: US\$ 95.

While this is primarily a traditional monograph, treating 22 genera and 192 species of parmelioid lichens in the Indian subcontinent, it also has features of wider interest. These concern the history of the study of these lichens in India, narrowing generic concepts, a proposal to establish eight "lichen sanctuaries", a table giving the regions, altitudes, number of localities and status of each species, and uses in traditional medicine. Anatomical and morphological characters are described, illustrated and discussed, the use of microcrystal tests and standard thin-layer chromatography procedures for identifying lichen compounds is explained, and there is an extensive glossary.

What did surprise me was that I could find no discussion on the issue of whether all the genera should or should not be accepted, especially as molecular data now make it clear that many should not, and the first author has made major contributions to tackling this problem in recent years (Blanco et al. 2004a, b, 2005; Divakar et al. 2006). This cannot just be explained only by the work being in press for a long time as the Foreword and Preface are both dated July 2004, the Literature Cited section includes some titles from 2003, and pertinent molecular work suggesting synonymizing would be necessary started to appear in 2001 (Crespo et al. 2001). An opportunity to promulgate the new generic concepts now being implemented has sadly been missed.

Having said that, the dated generic taxonomy does not detract from the value of this work for identification and information on the ecology, distribution and status of the species. For each species information is provided on the place of publication of the name, selected synonyms, type collections (where it would have been useful to indicate which had been examined and which had not), habit photographs in colour, chromatographic profiles also in colour (the first time I have seen this done in a monograph), a description, chemical reagent tests and compounds present, remarks on identification, notes on habitat, altitude and distribution, distribution map (with states indicated), and details of specimens examined (including extra-Indian ones). Many of the habit photographs have evidently been prepared from dried reference specimens which means that the colours do not always reflect those in nature, for example, *Punctelia borreri* (pl. 51 fig. 1) is olive-grey not brown in the field. The keys are generally clear, though I would have preferred to see chemical characters used less often, especially when reagent tests cannot be used to make the distinctions. In all,

some 36 species are added to the previous Indian checklist (Awasthi 2000) for this group. There is also one new combination, *Parmelinopsis nagalandica* (syn. *Parmelia nagalandica*) comb. nov., hiding on p. 288.

This is clearly a landmark work for the identification of parmelioid lichens at species level, not only in India but in south-east Asia more generally, as many species have wide distributions. If you work on Asian macrolichens, this is a “must-have”, but I do fear it may delay the take-up of the refreshing new generic scheme being developed by the first author and his colleagues and which is already being embraced internationally.

Awasthi, D. D. (2000) *Lichenology in Indian Subcontinent*. Bishen Singh Mahendra Pal Singh, Dehra Dun.

Blanco, O., Crespo, A., Divakar, P. D., Elix, J. A. & Lumbsch, H. T. (2005) Molecular phylogeny of parmotreoid lichens (Ascomycota, Parmeliaceae). *Mycologia* 97: 150-159.

Blanco, O., Crespo, A., Divakar, P. K., Esslinger, T. L., Hawksworth, D. L. & Lumbsch, H. T. (2004a) *Melanelixia* and *Melanohalea*, two new genera segregated from *Melanelia* (Parmeliaceae) based on molecular and morphological data. *Mycological Research* 108: 873-884.

Blanco, O., Crespo, A., Elix, J. A., Hawksworth, D. L. & Lumbsch, H. T. (2004b) A molecular phylogeny and a new classification of parmelioid lichens containing *Xanthoparmelia*-type lichenan (Ascomycota, Lecanorales). *Taxon* 53: 959-975.

Crespo, A., Blanco, O. & Hawksworth, D. L. (2001) The potential of mitochondrial DNA for establishing phylogeny and stabilising generic concepts in the parmelioid lichens. *Taxon* 50: 807-819.

Divakar, P. D., Crespo, A., Blanco, O. & Lumbsch, H. T. (2006) Phylogenetic significance of morphological characters in the tropical *Hypotrachyna* clade of parmelioid lichens (Parmeliaceae, Ascomycota). *Molecular Phylogenetics and Evolution* 40: 448-458.

Die Flechten Voralbergs. By Veronika Pfefferkorn-Dellali & Roman Türk. 2005. Inatura Erlebnis Naturschau, Jahnstrasse 9, A-6850 Dornbirn, Austria. [Voralberger Naturschau, Forschen und Entdecken No. 17.] Pp. 247. ISSN 1024-9613. Price: 18.18 €.

This provides an up-to-date checklist of the Voralberg district of Austria, well-known to be exceptionally rich in lichens, based on both literature reports and new field work. Following a short introduction including information on climate and maps and photographs of some rare and endangered species. The total number of taxa treated is 1069, of which five are new reports for Austria; lichenicolous fungi are not covered. The entries for each species include information on growth-form, ecology, where appropriate conservation status, literature sources, and distribution maps. This section is also interspersed with superb colour photographs of selected species. The nomenclature is generally current, though the latest results for generic re-circumscriptions in parmelioid lichens published in 2004 were not caught before the text went to press; I also wonder if the acceptance of *Lobarina* is premature. An important handbook for all lichenologists visiting the region, which will also be an important tool in developing and implementing conservation policies.

Shetland Lichens. By D. H. "Kery" Dalby & Claire Dalby. 2005. Shetland Amenity Trust, Garthspool, Lerwick, Shetland ZE1 0NY, UK (e-mail: shetamenity.trust@zetnet.co.uk). Pp. vii + 120, illustrated. ISBN 0 9543246 3 3, Price: £ 15.

This is much more than a survey of the lichens recorded in the Shetland Islands, the UK's northernmost outposts where the nearest rail station is in Norway, and very much a book for the enquiring general naturalist wanting to know more about lichens. It consequently starts with the issue of "What are lichens?", which includes accounts of lichen structures, aspects of their biology, and numerous tid-bits of observations that have fascinated the authors – and all well-illustrated by not only photographs but superb line drawings (a few in colour) by Claire Dalby – an established and justifiably renowned botanical artist. The tit-bits include contact zones between lichens, zonate growth, *Lichina confinis* as a pathogen of *Verrucaria maura*, and the separation of *Ramalina cuspidata* and *R. siliquosa*. Sections on lichen communities of different substrates follow, along with short chapters on effects of grazing (with a fine photograph of almost crustose *R. siliquosa* on p. 42), weather, human influences and uses, distribution types, and conservation. There are some statements that specialists would wish to amend, and I doubt the photograph labelled as *V. maura* on p. 16 is that species as it lacks the cracked-areolate thallus and the perithecia are too prominent. However, these small things do not detract from the main aim of these sections, to fascinate and encourage general naturalists into taking more note of lichens.

The more traditional information to be expected in regional "floristic" studies does not start until almost the middle of the book, with a history of studies in Shetland, but one that surprisingly omits mention of the records made by either George Low on his tour in 1774, or of Gunnar Degelius' visit in 1956. The individual species entries mention the individual islands from which species are known (and whether they are also recorded from the Orkney Islands just to the south is also indicated), and include ecological notes and references to recorders and published reports. A novel aspect is the printing of entries for Red data book threatened species in red! A draft if the checklist was checked by Brian C. Coppins (Royal Botanic Gardens, Edinburgh), and some records made by others remain doubtful in the absence of voucher specimens. There are surely more crustose species still to be found on rocks in the islands, but with hardly any trees able to get to more than 1-2 m in height, and those mainly in specially-protected sites, the list of those on bark and wood is unlikely to be swelled significantly by future work.

The Dalby's have been visiting the Shetland Islands annually since 1978, and the book reflects the love they clearly developed for the islands and their lichens – something I can very much relate to from my visits there in 1965-66!

Els Líquens Epífits com a Indicadors de l'Estat de Conservació del Bosc Mediterrani: proposa metodològica per als alzinars de Catalunya. By Àngels Longán Seminago. 2006. Institut d'Estudis Catalans, Carrer del Carme 47, E-08001 Barcelona, Spain (e-mail: informacio@iec.cat). [Arxius de les Seccions de Ciències, Secció de Ciències Biològiques No. 137.] Pp. 633, figs 33, coloured photos 16, tables 25, maps 166. ISBN 84 7283 837 4. Price: 30 €.

This book is based on a PhD thesis prepared under the supervision of A. Gómez-Bolea in the Universitat de Barcelona, and gained the Institut d'Estudis Catalans' award for ecology in 2003. Although the primary focus is the use of lichens as indicators of ecological continuity in *Quercus ilex* forests in Catalunya, attention is drawn to it here as just under half of the book consists of treatments of 166 different species; these include information on identification and ecology, but further distribution maps and details of specimens examined. Eighteen species are first records for Catalunya, six are new to the Iberian Peninsula, and one was new to science (*Byssoloma llimoniae*, but previously published elsewhere). In addition, four species differed from the ones they were closest to in some features (*Agonimia allobata*, *Lecanora strobilinoidea*, *Lecanora expallens*, and *Psoroglaena stigonemoides*), and two could be named beyond genus (*Catillaria* sp. and *Micarea* sp.). It is not appropriate to discuss the ecological results in detail here, but detailed information is given on the 45 plots studied, and a novel Index Liquénic (IL; Lichen index of conservation status) is introduced using positive and negative indicator species. This is a land-mark publication for assessing the conservation status of these special forests, and the approaches merit emulation in evergreen oak forests throughout the Iberian Peninsula. Although the work is in Catalan, there is a 42 page (!) English summary, and the tables and figures all have titles in both languages, so making the content more accessible to an international audience than would otherwise have been the case.

Flora Polski: Porosty, Mszaki, Paprotniki. By Hanna Wójciak. 2003. Multico Oficyna Wydawnicza, ul. Lektykarska 4a, PL-01-687 Warszawa, Poland (e-mail: biuro@multicobooks.com.pl). Pp. 368, illustrated. ISBN 83 7073 223 2. Price: 64 zł.

This semi-popular guide to lichens, bryophytes, and pteridophytes, was prepared by a lichenologist at the Uniwersytetu Marii Curie-Skłodowskiej in Lublin, who is clearly also a most competent photographer. Over half of the work is devoted to lichens, and starts with an introduction to lichen structure and ecology, including a comparison of air pollution lichen zones in Kraków in 1950 and 1990. It then treats around 350 species, arranged systematically, rather than alphabetically or by thallus-type, which makes a particular species difficult to find without recourse to the index. The Polish common names are

given prominence, followed by the scientific name and often used synonyms, the family placement, a description, notes on ecology, distribution, and conservation status, and the colour photographs. Most of the photographs are fine, but in some the colour balance has sadly been skewed to the extent that users might be misled (e.g. *Pertusaria pertusa*, *Phylctis argena*, *Physcia dubia*). In some other cases, colour problems may well arise from herbarium specimens probably having been used (e.g. *Physconia distorta*). As so many Polish works on lichens lack any photographs, this book is sure to do much to help naturalists start to take an interest in lichens. I hope Hanna will be encouraged by the success of this work in promoting lichenology, and consider preparing a volume solely devoted to lichens.

Conidial fungi

Phylogenetic relationships and morphology of *Cytospora* species and related teleomorphs (*Ascomycota*, *Diaporthales*, *Valsaceae*) from *Eucalyptus*. By Gerard C. Adams, Michael J. Wingfield, Ralph Common & Jolanda Roux. 2005. Centraalbureau voor Schimmelcultures, P.O. Box 85167, 3508 AD Utrecht, The Netherlands (e-mail: info@cbs.knaw.nl). [Studies in Mycology No. 52.] Pp. x + 147. ISBN 10: 90 70351 57 9, 13: 978 90 70351 571. Price: 55 €.

The *Diaporthales* and their coelomycete anamorphs have long presented major problems in identification, with few mycologists prepared to tackle them because of the scale of the task. This contribution, however, aiming to resolve the situation by focussing on one anamorph type and its teleomorphs on particular hosts, is commendable – and even more so because it combines critical morphological studies with work on cultures and molecular phylogenetic approaches. However, the first third of this work is devoted to categorizing the conidioma and ascoma types, culture methods, and cycloheximide sensitivities that will make this a pivotal work in all future investigations on these fungi on any hosts.

Studies on ITS sequences from material on *Eucalyptus*, where these fungi are often associated with cankers, yielded 33 unique sequences placed in at least 15 unrelated groups, but a pragmatic nomenclatural approach is adopted which accepts *Luecostoma*, *Valsella*, and *Valseutypella* all as synonyms of *Valsa*. One *Cytospora* was placed close to the *Phomopsis* anamorphs of *Diaporthe* – suggesting there may be more surprises when more molecular data is available on those fungi. In the taxonomic part of the work, 23 *Cytospora* species are accepted, nine of which have known teleomorphs in *Valsa*, together with data on some yet undetermined specimens. All are described in detail with superb drawings and micrographs, almost all in colour, along with photographs of cultures. Eight new *Cytospora* and four new *Valsa* species are described, and emended descriptions of previously described species provided.

With the care taken to synthesize morphological, molecular, cultural, and nomenclatural investigations as a team, and further provide so many superb illustrations in colour, this is a superb example of how systematic studies of the 21st century should be conducted and presented.

Grzyby z rodzaju *Ramularia* występujące w Polsce [Fungi of the genus *Ramularia* in Poland]. By Agata Wołczańska. 2005. Polish Botanical Society, Łódź, Poland. Pp. 154, figs 18, plates 7. [Monographiae Botanicae Vol. 95.] In Polish. ISSN 0077-0655, ISBN 83 86292 67 9. Price: 5 €.

Ramularia is a large genus of mucedinaceous hyphomycetes, as far as is known comprising anamorphs of the ascomycete genus *Mycosphaerella* (*Mycosphaerellaceae*). About 330 mainly hemibiotrophic, leaf-spotting species have been assigned to this genus, and they predominantly occur in temperate regions of the Northern Hemisphere. Numerous economically important plant diseases of phytopathological significance are involved.

Wołczańska carried out a careful, detailed revision of this genus in Poland, based on re-examinations of collections deposited in Polish herbaria as well as data spread in literature. Introductory chapters contain surveys of the history of *Ramularia* in general and in Poland in particular, material and methods, biology, including some scanning electron microscopic pictures of conidiophores and conidia, an analysis of *Ramularia* species found in Poland in relation to host plant families, as well as a key to *Ramularia* and allied genera. Six colour plates show symptoms and fungal colonies of various *Ramularia* species. Following a general description of the genus *Ramularia*, the particular species are arranged according to host plant families, supplemented by keys to species when two or more species are known. The species are treated in the best traditions of classic fungal monographs, comprising bibliographic references, synonyms, exsiccatae, descriptions of morphological features and detailed data on host range and distribution, including literature references and herbarium samples, and comments following the monograph of *Ramularia* published by Braun (1998). Illustrations of microscopic features are confined to drawings of conidia, giving impressions of the conidial shapes and sizes. However, because complete pictures of the particular species, including conidiophores, stromata, etc., are lacking, it would have been useful to give references to appropriate illustrations in the literature, for example to those in Braun (1998) whose descriptions and drawings from that work are now freely available via internet through MycoBank.

The treatment of Polish *Ramularia* species is finished by a survey of excluded former *Ramularia* species, a host/fungus list, references, and indexes of scientific fungal and host names.

In total, 115 *Ramularia* species, including one species on a fern, three on five rust fungi, and 111 on 304 angiosperm species belonging to 38 families, are described and illustrated from Poland.

The present monograph represents an important, useful contribution to the knowledge of the genus *Ramularia*, and is recommendable to mycologists and phytopathologists interested in leaf-spotting hyphomycetes.

UWE BRAUN

*Institut für Biologie, Bereich Geobotanik, Martin-Luther-Universität
Neuwerk 21, D-06099 Halle/Salle, Germany*

Braun, U. (1998) *A Monograph of Cercosporiopsis, Ramularia, and allied Genera*. IHW-Verlag, Eching.

The Missing Lineages: phylogeny and ecology of endophytic and other enigmatic root-associated fungi. Edited by Richard C. Summerbell, Randolph S. Currah & Lynne Sigler. 2005. Centraalbureau voor Schimmelcultures, P.O. Box 85167, 3508 AD Utrecht, The Netherlands (e-mail: info@cbs.knaw.nl). [Studies in Mycology No. 53.] Pp. vi + 262. ISBN 10: 90 70351 58 7, 13: 978 7989979870351 58 8. Price: 65 €.

This number of *Studies in Mycology* brings together a series of contributions shedding new light on the identities and positions of a range of mainly dematiaceous often sterile fungi encountered as endophytes or associated with plant roots. The papers are wide-ranging. Sterile fungi from ericaceous roots fall into different subclades of what is clearly a complex of taxa going under the designation *Hymenoscyphus ericae*; a new genus name *Melinomyces* with three species which are totally sterile and form subclades distinct from *H. ericae* s.str. is introduced (Sarah Hambleton & Lynne Sigler, pp. 1-27). The new genus *Leohumicola*, with four species, three newly described and one recombined have been isolated from heat-treated soils in Canada; they have lateral or terminal brown aleuroconidia which can be smooth or warted and molecular data shows them to belong to a monophyletic group in *Leotiomycetes* (Sarah Hambleton et al., pp. 29-52). Isolates from ericaceous roots in North America were encouraged to sporulate in culture and found to represent two new species of *Cryptosporiopsis* (Lynne Sigler et al., pp. 53-62). A method for identifying the ericoid mycobiont *Oidiodendron maius* by colony characteristics under precise conditions has been developed (Lynne Sigler & Connie Fe Gibas, pp. 63-74). A new *Oidiodendron* species is described from mushroom compost, and a synopsis of the 23 named species and related anamorphs of *Myxotrichum* is provided along with descriptions, illustrations, and keys (Adrianne Rice & Randolph Currah, pp. 75-82 and 83-120, respectively).

Richard Summerbell (pp. 121-145) examined the endophytes and mycorrhizosphere fungi of *Picea mariana* growing in sites with different

conditions, and concludes that the soil and the microbial community are the determinants of the assemblages and not the mycorrhizosphere. Jantineke et al. (pp. 147-162) compared the root endophytes of ericaceous plants and *Deschampsia flexuosa* in the Dutch heathlands, also carrying out inoculation experiments; the fungi were mainly helotialean and overlapped phylogenetically and in function. Lawrence Zettler et al. (pp. 163-171) set out to determine if the protocorm mycobiont of the orchid *Platanthera leucophaea* was also present in and encouraged growth in seedlings; it was *Ceratorhiza goodyerae-repentis* and it did.

The issue closes with two review papers: one by Keerthi Mandyam & Ari Jumpponen (pp. 173-189) on the importance and possible roles of dark septate endophytes; and an amazing *tour de force* by Richard Summerbell (pp. 191-256) in which he assembles and analyzes the scattered pre-1985 literature (which extends over 14 pages) on endophytic and saprotrophic fungi associated with ectomycorrhizal roots.

With its combination of contributions on systematics, ecology and biology, and reviews, this will be an important reference work for all fungal ecologists battling with dark septate endophytes.

Fungi of Australia: *Septoria*.. By Michael J. Priest. 2006. Australian Biological Resources Study and CSIRO Publishing, PO Box 1139, 150 Oxford Street, Collingwood, Victoria 3066, Australia (e-mail: publishing.sales@csiro.au). Pp. vi +259, figs 136. ISBN 0 643 05702. Price: A\$ 110.

This book, according to the author is based on his thesis submitted for a PhD degree at the University of New England, Armidale, NSW. It is a reassessment of *Septoria* species reported in Australia on the basis of previously published morphological and pathological data and contains accounts of 132 *Septoria* species occurring on flowering plants representing 54 plant families.

The first part (pp. 1-13) of the book has an Introduction which includes a résumé on the history of the name *Septoria*, taxonomic characters including conidiomata, the current interpretation of conidiogenesis, conidia, host specificity, brief notes on closely related genera, host relationship, and biogeography. Although the generic characters of *Septoria* previously accepted by mycologists have been reviewed and recent findings about conidiogenous cells in the type species *S. cytisi* and *S. chrysanthemella* have been noted, and current terminology elucidated, a clear and concise generic description of *Septoria* defined for this book does not appear before the start of the reassessment of *Septoria* species on a host family basis.

Apparently not consulted in the preparation of this book are relevant or recent or fairly major publications on *Septoria* which include a publication by Teterevnikova-Babayana (1987) which deals with 850 taxa from the former

USSR, and the more recent publication by Muthumary (1999⁷) which deals with 83 Indian *Septoria* species including new species from *Hydrocotyle* and has good illustrations, and Markevičius & Treigienė's (2003⁸) treatment of Lithuanian *Septoria* species.

The main part and bulk of this book contains descriptions of accepted *Septoria* species in Australia with line drawings (pp.15-214). There are separate, mini keys to *Septoria* species on members of *Apiaceae* (6), *Asteraceae* (22), *Caryophyllaceae* (4), *Fabaceae* (4), *Mimosaceae* (4), and *Poaceae* (14). Unfortunately there is no organism-based single key independent of the host to accepted *Septoria* species occurring in Australia. A single key is essential since it would reveal at a glance morphologically similar groups having similar conidial dimensions and septation but regarded as different entities or species on hosts basis. Apparently no attempt has been made to group *Septoria* species on the basis of the conidiogenous.

The taxonomic criteria adopted in this book seem to vary in places as the following example demonstrates. In the text, five taxa, *Stagonospora avenae*, *S. nodorum*, and *Septoria capillepedii* and *S. cryptica* and *S. cymbopogonis* have identical descriptions for the conidiogenous cells, i.e. "arising from the inner wall layer, hyaline . . . producing 1 or more conidia holoblastically; secession schizolytic, subsequent proliferation of the conidiogenous locus not observed", but in this book *Septoria avenae* and *S. nodorum* are accepted in *Stagonospora* and the other three species are included in *Septoria*. Bissett (1982) transferred *Septoria avenae* to *Stagonospora* because he believed that *S. avenae* was congeneric with *Stagonospora nodorum* but not with the type species of *Septoria*, *Septoria cytisi*. Castellani & Germano (1977) transferred *Septoria nodorum* to *Stagonospora* on the basis of conidial width and not on the basis of conidiogenous cells. The obvious reason for the placement of the two *Septoria* species in *Stagonospora* in publications is not influenced by the type of conidiogenous cells or conidiogenesis, but because the two taxa have *Leptosphaeria* teleomorphs. This logic, however, does not explain the placement of taxa with similar generic characters in different anamorph genera.

It is interesting that the leaf scorch fungus of *Azalea* (i.e. *Rhododendron*), *Septoria azaleae*, was described and illustrated by Voglino (1899: pl. 2-3) with good line drawings showing pycnidial conidiomata and the early stages of pycnidial development. Also, he illustrated an immature pycnidium showing a well-formed pycnidial cavity (pl. 3). It is also worth noting that Voglino (1899) described the conidia of *S. azaleae* as 0-3-septate and 12-18 x 1.5-2 µm. Grove (1935) gave the measurements for the same species as 15-20 x 2.5 µm, and

⁷ Reviewed in *Mycotaxon* 85: 486 (2003).

⁸ Reviewed in *Mycotaxon* 90: 492 (2004).

from another collection recorded measurements of $11\text{--}34 \times 1.5\text{--}2.5 \mu\text{m}$. Grove also reported that 'on damp leaves, spores give rise to secondary conidia, $7\text{--}11 \times 2\text{--}3 \mu\text{m}$ by which the disease is spread'. Priest widened the measurements of conidia to $(11\text{--})15\text{--}35\text{--}(43)$ and illustrated them as having a wide range of shapes and sizes (p. 105, fig. 61). It therefore seems that *S. azaleae* and other species reported from *Rhododendron* are in need of an in-depth study. It is amusing to note that, in *S. varia* (p. 151) conidia are described as having 'a rounded base tapering to a subacute apex', but conidia from the holotype are illustrated (p. 152, fig. 94C) with a distinctly acute base like the sharp point of a needle, gradually tapering towards the apices.

Although all accepted species are illustrated by line drawings, their quality is not up to standard; the lines are finely serrated giving the impression that conidia and ascospores have roughened cell walls when they are smooth (figs 2, 8, 11, 27-28, 34, 48-49, 54, 56, 62, 65, 110, 114, 120, 131). When working with a single genus like *Septoria*, it is always helpful to illustrate conidia at the same magnification for ease of comparison, but unfortunately in this book the conidia are illustrated at different magnifications. It is also a pity that important structures are not illustrated by photomicrographs. For example, the line drawing of a part of a conidioma of *S. petroselinii* (p. 27, fig. 9B) shows a simple holoblastic conidiogenous cell next to a sympodially proliferating conidigenous cell, which in turn is next to a 'phialide' or enteroblastic conidiogenous cell (or percurrently proliferating cell). Such an occurrence of three types of conidiogenous cells aligned next to each other in the correct sequence within a single pycnidium is not a common feature and would be best illustrated by photomicrographs. It is also interesting to note that the illustration of the vertical section of the pycnidial conidioma of the same species (p. 27, fig. 9A) shows only holoblastic conidiogenous cells arising from the innermost cell layers lining the pycnidial cavity.

There are several line drawings of conidiomata devoid of contents and which do not show any conidiogenous cells arising from the innermost cell layer lining the pycnidial cavity (figs 13A, 14A, 19A, 20A-25A, 27A, 28A, 31A, 32A, 34A, 36A-39A, 41A-43A, 45A-48A, 49A-55A, 57A-59A, 61A, 63A, 64A-82A, 84A-109, 111A-136A). It is doubtful if these illustrations serve a useful purpose here. Further, the sketch of a vertical section of a conidioma of *Clypeopycnis lepidospermatis* (syn. *Septoria lepidospermatis*; p. 102, fig. 59A) is entirely different from the very well-produced line drawings of the same species published by Sutton & Pascoe (1989) which clearly show that the conidiomatal wall (p. 183, fig. 4) has two distinct types of cell layers. It is also worth noting here that the correlation between *Mycosphaerella lepidospermatis* and *C. lepidospermatis* is not conclusively established but only circumstantial, as pointed out by Sutton & Pascoe (1989).

Doubtful and Excluded names take up eight pages (pp. 215-222), followed by a four-page appendix (pp. 223-226) that deals with new species, combinations and lectotypifications. Towards the end there is a Glossary (pp. 227-230) followed by an adequate list of references (pp. 231-244). Abbreviations and contractions used (pp. 245-248) are followed by fungus (pp. 49-254) and host (pp. 255-259) indices. The fungus index is almost free of errors, but *Pycnofusarium* is on p. 9 and not on p. 10, *Pyrenopeziza brassicae* is on p. 7 and not p. 8, *Septoria ceratoniae* is on p. 216 and not p. 215, and *S. eucalypti* is on p. 217 and not p. 216.

This book, produced with an attractive hard cover, brings together records of accepted and doubtful Australian *Septoria* species and excluded names in a single publication. It is a significant and useful contribution that will be appreciated by mycologists and plant pathologists.

- Bissett, J. (1982) *Stagonospora avenae* [as '*avena*']. Fungi Canadenses No. 239. National Mycological Herbarium, Biosystematics Research Institute, Agriculture Canada, Ottawa.
- Grove, W.B. (1935) *British Stem and Leaf Fungi*. Vol. 1. *Sphaeropsidales*. Cambridge University Press, Cambridge.
- Castellani E. & Germano, G. (1977) Le Stagonosporae graminicole. Annali della Facoltà di Scienze Agraria della Università degli Studi di Torino 10: 1-135.
- Markevičius, V. & Treigienė, A. (2004) ['2003'] *Septoria*. [Spuogagybiečiai (*Sphaeropsidales*): Gentis *Septoria*.] [Mycota Lithuaniae/Lietuvos Grybai Vol.10 (3).] Botanikos Institutas, Vilnius.
- Muthumary, J. (1999) *First Contribution to a Monograph of Septoria species in India*. Centre for Advanced Studies in Botany, University of Madras, Chennai.
- Sutton, B. C. & Pascoe, I. G. (1989) Some *Septoria* species on native Australian plants. Studies in Mycology 31: 177-186.
- Teterevnikova-Babajan, D. M. (1987) Griby roda Septoriya v SSSR [Fungus of the genus *Septoria* in the USSR]. Akademiya Nauk Armyanoskoi SSR Institut Botaniki Izd. an Armyanskoi SSR, Erevan
- Vogolino, P. (1899) Di una nuova malattia dell' *Azalea indica*. Malpighia 13: 73 – 86.

ELIYATHAMBY PUNITHALINGAM

7 Brook Court, Parkleys, Richmond, Surrey TW10 5LX, UK.

Miscellaneous

International Code of Botanical Nomenclature (Vienna Code) adopted by the Seventeenth International Botanical Congress Vienna, Austria, July 2005. Edited by John McNeill, Fred R. Barrie, Hervet M. Burdet, Vincent Demoulin, David L. Hawksworth, K. Marhold, Dan H. Nicolson, José Prado, Paul C. Silva, Judy E. Skog, John H. Wiersma & Nicholas J. Turland. 2006. A. R. G. Ganter Verlag, Ruggell, Liechtenstein. [Distributed by Koeltz Scientific Books, P. O. Box 1360, D-61453 Koenigstein, Germany (e-mail: koeltz@t-online.de).] [Regnum Vegetabile No. 146.] Pp. xviii + 568. ISBN 3 906166 48 1. Price: 48 €.

This new edition of the Code replaces the St Louis Code published in 2000⁹. The main changes affecting mycologists relate to new provisions in Art. 59 relating to the epitypification of anamorphs by material with the teleomorph, and accepting as validly published names of fungi (such as microsporidians and *Pneumocystis*), which were originally described under the zoological Code in the belief that they were animals (Art. 45.5). The Preface also encourages the use of italics for scientific names of all ranks, which has been its practice for many decades, "in the interest of international uniformity" (p. viii). There are also clarifications over the effective publication of theses, the validity of new combinations, and electronic publication. A glossary of nomenclatural terms used and defined in the Code is included for the first time.

Solomon P. Wasser (in honour of his 60th birthday). Edited by K. M. Sytnik. 2006. N. G. Kholodny Institute of Botany, Kiev, Ukraine. Pp. 120 pp. ISBN Not indicated. Price: Not indicated.

This little book is a record of a remarkable figure in mycology and algology. It comprises an editorial, a detailed biography by Irena Dudka and Asya Buchalo (presented in Ukrainian and English), publications list, and a remarkable collection of photographs from Wasser's personal and scientific life. Unusually, he has continued to be active in both mycology and algology, though edible mushrooms, especially *Agaricus* species and their applications have long been his main passion. The publications list includes 417 titles, amongst which are some 40 books (including several well-illustrated semi-popular mushroom guides). All titles are given in English, will help make those in Russian and Ukrainian more accessible. Within these, 128 new species, 55 new varieties, and 22 new forms of agarics are described. And he also holds 12 patents concerned with mushroom products. Since 1995, he has been part of the Institute of Evolution in Haifa, where he is head of the International Center of Biotechnology and Biodiversity of Fungi and Algae, but he keeps in contact with his colleagues in Kiev bringing refreshing ideas to them on his visits back (according to the editor). In addition to editing two phycological journals, in 1999 he founded the *International Journal of Medicinal Mushrooms*, and subsequently was instrumental in establishing the series of international congresses of medicinal mushrooms, the first of which was held in Kiev in 2001. A fine tribute and record of achievement for a very special figure in mushrooms and their applications, which all who know his work but do not know the man will find fascinating. *Mycotaxon* joins in sending him its best wishes in his future endeavours.

⁹ Reviewed in *Mycotaxon* 76: 496 (2000).

Erratum

Die Pilzflora des Ulmer Raumes. By Manfred Enderle. 2004. [Reviewed in *Mycotaxon* 94: 375-376 (2005).]

The e-mail address for orders was incomplete in the published review and should have been: manfred.enderle@gmx.de. I apologise for any inconvenience caused.

NOMENCLATURAL NOVELTIES PROPOSED IN MYCOTAXON 98

- Astrosphaeriella linguiformis* Chi Y. Chen & J.W. Huang, p. 120
- Beauveria malawiensis* S.A. Rehner & Aquino de Muro, p. 140
- Chroodiscus himalayanus* Nayaka & Upreti, p. 247
- Coprinus doverii* L. Nagy, p. 148
- Cystolepiota fumosifolia* (Murrill) Vellinga, p. 226
- Cystolepiota oregonensis* (H.V. Sm.) Vellinga, p. 228
- Cystolepiota petasiformis* (Murrill) Vellinga, p. 228
- Haradaea moehringiae* (Togashi & Y. Maki) Denchev, p. 182
- Kirschsteiniothelia reticulata* Chi Y. Chen, C.L. Wang & J.W. Huang, p. 154
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p. 369, line 9	for: <i>G. argentius</i>	read: <i>G. argentea</i>
p. 371, line 28	for: <i>G. argentius</i>	read: <i>G. argentea</i>
p. 372, line 15	for: <i>Graphis argentius</i> Makhija & Adaw., <i>sp. nov.</i>	
	read: <i>Graphis argentea</i> Makhija & Adaw., <i>sp. nov.</i>	
p. 372, 6 th from bottom	for: <i>Graphis argentius</i>	read: <i>Graphis argentea</i>
p. 373, line 3	for: <i>G. argentius</i>	read: <i>G. argentea</i>
p. 374, legend, top line	for: 1. <i>Graphis argentius</i>	read: 1. <i>Graphis argentea</i>
p. 525, line 18	for: <i>Graphis argentius</i> Makhija & Adaw., p. 372	
	read: <i>Graphis argentea</i> Makhija & Adaw., p. 372	

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p. 76, line 7	for: <i>forma conigena</i>	read: <i>forma conigenum</i>
	for: <i>Lophodermium congena</i>	read: <i>Lophodermium conigenum</i>
p. 123, line 15 of tree	for: macgregorii	read: macgregorii
p. 155, line 21	for: <i>Microstoma insititia</i>	read: <i>Microstoma insititium</i>
p. 158, line 7	for: <i>Cookeina insititia</i>	read: <i>Cookeina insititia</i>
p. 174, line 33	for: <i>elata</i> – <i>Geopyxis</i>	read: <i>elata</i> – <i>Geopyxis</i>
p. 175, line 24	for: <i>Pilocratera novo-guianensiis</i>	read: <i>Pilicratera novoguianensis</i>
p. 190, line 8	for: <i>potentillae anserinae</i>	read: <i>potentillae-anserinae</i>
line 9	for: <i>potentillae sterilis</i>	read: <i>potentillae-sterilis</i>
line 11	for: <i>viciae sativae</i>	read: <i>viciae-sativae</i>
p. 214, tree, 2 from bottom:	for: <i>A. flettii</i>	read: <i>Albatrellus flettii</i>
tree, bottom entry:	for: <i>G. aculeatum</i>	read: <i>Gloeocystidiellum aculeatum</i>
p. 341, after line 24	insert: <i>Placopyrenium stanfordii</i> (Herre) K. Knudsen, p. 310	

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With this volume, we reluctantly bid bon voyage to MYCOTAXON friend and co-founder Grégoire L. Hennebert, who has edited all French language manuscripts for our journal since its founding in 1974. We take this opportunity to wish Grégoire a happy (and well deserved) leisure from MYCOTAXON duties.

At the same time, it is our pleasure to welcome — as new French Language Editor — Grégoire's fellow Belgian and 'hand-picked' successor: Cony Decock, Curator of MUCL (Mycothèque de l'Université catholique de Louvain), well-respected basidiomycete systematist, and frequent MYCOTAXON contributor.

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Pacific Northwest Mycology Service
6720 NW Skyline Boulevard
Portland, OR 97229, U.S.A.

Shaun R. Pennycook, NOMENCLATURE EDITOR
PennycookS@LandcareResearch.co.nz
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David L. Hawksworth
BOOK REVIEW EDITOR
MycNova, Calle Aguila 12
Colonia La Maliciosa, Mataelpino
ES-28411 Madrid, Spain

Karen D. Gettelman
INDEX EDITOR
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U.S.A.

Cony Decock
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